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REPORT NO. 8820-3 27 April 1956

STATIC CHARACTERISTICS OF THE RYAN MODEL 88 MONOPLANE AND BIPLANE-TYPE APPARATUS FOR DEFLECTING A PROPELLER SLIPSTREAM THROUGH LARGE ANGLES

CONTRACT NO. NOnr-17[illegible]0(00)

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RYAN AERONAUTICAL COMPANY

LINDBERGH FIELD SAN DIEGO, CALIFORNIA

[redacted]

REPORT NO. 8820-3

27 APRIL 1956

STATIC CHARACTERISTICS OF THE RYAN MODEL 88 MONOPLANE AND BIPLANE-TYPE APPARATUS FOR DEFLECTING A PROPELLER SLIPSTREAM THROUGH LARGE ANGLES

CONTRACT NO. Nonr-1710(00)

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Number of Figures: 14

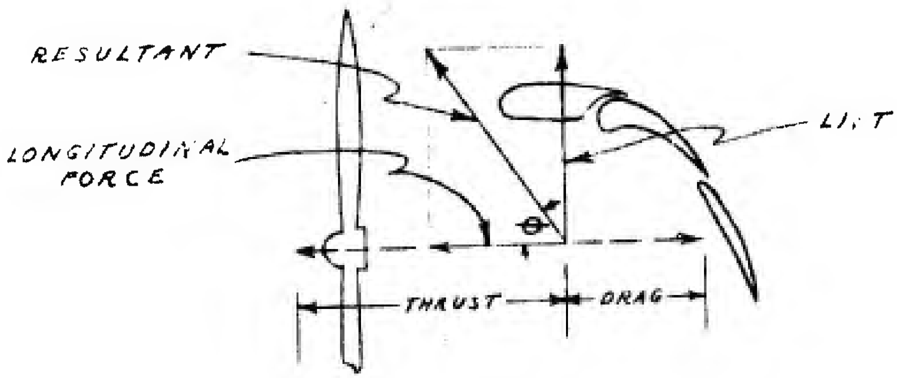
2.0 PREFACE

This report has been prepared and is submitted under Contract No. Nonr-1710(00).

3.0 TABLE OF CONTENTS

4.0 SUMMARY

A series of tests were conducted at the contractor s facility to determine the static aerodynamic characteristics of the Ryan Model 88 Monoplane- and Biplane-type apparatus incorporating trailing edge flap arrangements for deflecting a propeller slipstream through large angles, as shown schematically in the sketch below:



A resultant-thrust ratio of approximately 0.99 with a corresponding slipstream turning angle of approximately 60° was measured in the presence of a ground plane with the monoplane apparatus. These values reduce to approximately 0.83 and 49°, respectively, when the ground plane is removed.

The largest slipstream turning angle obtained with the monoplane apparatus was approximately 71° with a corresponding resultant-thrust ratio of approximately 0.76 in the presence of a ground plane. These values reduce to approximately 67° and 0.69, respectively, when the ground plane is removed.

A resultant-thrust ratio of approximately 1.01 with a corresponding slipstream turning angle of approximately 58° was measured in the presence of a ground plane with the biplane apparatus.

The largest slipstream turning angle obtained with the biplane apparatus was approximately 61° with a corresponding resultant-thrust ratio of approximately 0.92 in the presence of a ground plane.

The resultant-thrust and slipstream turning angle appear to be reduced by approximately 0.08 and 5°, respectively, when the ground plane is removed from the biplane configuration.

Auxiliary vanes were installed on both the monoplane and biplane configurations to assist in turning the slipstream. All vanes tested exhibited a similar tendency of increasing the turning angle but reducing the resultant-thrust ratio.

Pitching moment measurements indicate that a significant nose-up moment change results when the ground plane is removed or when the flaps are retracted. Rolling and yawing moments appear to remain essentially unaffected by any corresponding configuration changes.

Auxiliary vanes were also employed during the tests to investigate the extent of control possible by these means. All of the vanes gave relatively small moment changes for relatively large vane-position variations and vane angle of incidence changes.

The aft flap was hinged at its mid-chord to explore the characteristics of a more or less conventional-type control device. This scheme was rather ineffective in producing moment changes. A full-span, flap-type, slot-lip spoiler was rather ineffective in producing significant pitching and yawing moment changes although rolling moments are moderately affected.

5.0 NOMENCLATURE

Symbol	Item
L	Lift, lbs.
L.F.	Longitudinal Force, lbs.
S.F.	Side Force, lbs.
M	Pitching moment for the monoplane taken about an axis passing through a point on the thrust line directly beneath and parallel to the wing C/4 line (nose-up-positive), ft. lbs.
M	Pitching moment for the biplane taken about an axis passing through the thrust line at the intersection of the thrust line and a line drawn between the C/4 lines of each wing (nose-up-positive), ft. lbs.
N	Yawing moment for the monoplane taken about an axis perpendicular to the horizontal plane of thrust and passing through the wing C/4 line at the right hand tip (nose right-positive), ft. lbs.
N	Yawing moment for the biplane taken about an axis perpendicular to the horizontal plane of thrust at the right hand wing tip on a line parallel to the wing C/4 line passing through the intersection of the thrust line and a line drawn between the C/4 lines of each wing (nose right-positive), ft. lbs.
ℓ	Rolling moment for the monoplane and biplane taken about an axis parallel to the thrust line and lying in the horizontal plane of thrust directly beneath the right hand wing tip (right wing down-positive), ft. lbs.
C_m	Pitching moment-coefficient $= \dfrac{M}{q'' S\ c}$
C_n	Yawing-moment-coefficient $= \dfrac{N}{q''\ S\ b}$
C_ℓ	Rolling moment-coefficient $= \dfrac{\ell}{q''\ S\ b}$
q''	Dynamic pressure in slipstream, $4T/\pi D^2$, lbs/ft.^{2}
S	Wing area (semi-span), sq. ft.

c	Wing chord, ft.
b	Wing span (semi-span), ft.
T	Propeller thrust, lbs.
D	Propeller diameter, ft.
F	Static or tare reading of gage on balance system, psi
1, 2, etc.	Subscripts denoting a specific gage of the balance system
①, ②, etc.	Dynamic readings of a specific gage of the balance system, psi
A	Distance above thrust line to leading edge of wing above thrust line, inches
A_1	Distance below thrust line to leading edge of wing below the thrust line, inches
B	Distance from propeller plane to leading edge of wing above the thrust line, inches
B_1	Distance from propeller plane to leading edge of wing below the thrust line, inches
C	Angle of incidence of wing above the thrust line, degrees
C_1	Angle of incidence of wing below the thrust line, degrees
D	Deflection angle of the upper wing forward flap measured from the upper wing chord line, degrees
D_1	Deflection angle of the lower wing forward flap measured from the lower wing chord line, degrees
E	Deflection angle of upper wing aft flap measured from the reference line of the upper wing forward flap, degrees
E_1	Deflection angle of lower wing aft flap measured from the reference line of the lower wing forward flap, degrees
J	Distance from ground or ground plane to thrust line, measured in the propeller plane, inches
K	Angle that ground plane makes with propeller axis, degrees
L	Distance that trailing edge of the lowest aft flap is from the ground or ground plane, inches

θ	Inclination of resultant force vector from thrust line, degrees
R	Resultant force, pounds, $R = \sqrt{L^2 + (L.F.)^2}$
R/T	Resultant-thrust ratio
σ	Density ratio, ρ/ρ_o

6.0 INTRODUCTION

This report presents test data obtained from the Ryan Model 89 monoplane and biplane-type apparatus for deflecting a propeller-slipstream through large angles.

The principle of deflecting a propeller slipstream through large angles appears to have practical application in the design of a vertical take-off and landing (VTOL)airplane. Previous test results from other agencies have been obtained on small-scale models. It was considered desirable, therefore, to explore the concept on a full-scale basis prior to designing a flight article.

The results of the tests are presented in graphical form in Section 11.0 and tabular form in Section 12.0. Graphical data include plots of thrust, longitudinal-force per unit thrust, and coefficients of pitching moment, yawing moment, and rolling moment versus the lift per unit thrust.

The present tests were conducted at the contractor's facility between 24 August 1955 and 16 February 1956. The apparatus was designed and fabricated by the contractor.

7.0 METHOD OF APPROACH

7.1 Scope of Tests

7.1.1 Propellers. Several tests were conducted on both a two-bladed and three-bladed propeller to determine the effects of propeller blade angle on thrust, and to select the propeller to be used for the test program. The wing was not mounted for the propeller investigation.

7.1.2 Monoplane. The first portion of the test program was the investigation of a monoplane type apparatus simulating a semi-span wing. The wing incorporated a double flap arrangement which could be adjusted in a number of deflection combinations. These tests were run to establish configurations giving large slipstream turning angles and high resultant-thrust ratios. Several configurations of turning vanes, hinged flaps, and control vanes were also tested during these runs.

Pitching, yawing, and rolling moments were investigated during the monoplane tests with emphasis being placed on pitching moment for purposes of developing a method of control.

Ground effects were explored by placing an 18 x 18 foot plane in close proximity to the wing configuration under test.

7.1.3 Biplane. The second portion of the test program was devoted to the investigation of a biplane-type apparatus simulating a semi-span configuration. Each of the biplane wings incorporated the same double flap arrangement as was used for the monoplane tests. These tests were conducted

to establish the effectiveness of multiple surfaces in giving large slipstream turning angles and high resultant thrust ratios. One configuration of a turning vane was tested at several angles of incidence during one of the tests on the biplane.

Pitching, yawing, and rolling moments were investigated for all configurations of the biplane.

Ground effects for the biplane configuration were investigated by: (1) running tests with a ground plane installed, and (2) by inverting the wings on the test apparatus.

7.2 Description of Apparatus

7.2.1 General. Forces were measured on a balance system of hydraulic cylinders as shown in the sketch at the bottom of Figure 18. The cylinders were identical and each consisted of a 1-1/2 inch diameter piston on a 1/2 inch diameter rod. Pressure measurements were taken on both sides of the pistons by U. S. Gage Company "Supergages" reading from 0 to 600 pounds per square inch and graduated in 5 pounds per square inch graduations on a six inch diameter dial. Cylinder notations 1, 2, 3, 4, 5, and 6 refer to the small area ends of the pistons which have an area of 1.571 square inches. Cylinder notations 7, 8, 9, 10, 11, and 12 refer to the large area ends of the pistons which have an area of 1.767 square inches. The wing (or wings) and power plant were connected to the balance system by a common mounting.

In order to simulate ground effects, a plane 18 feet by 18 feet was constructed and placed on independent supports in close proximity to the

engine-propeller and wing for both the monoplane and biplane tests. No forces were transmitted from the ground plane to the balance system by virtue of the independent mounting. Figures 1 through 14 are photographs of several test configurations showing ground plane installed and removed.

A series of calibration runs were made with the wing removed to establish a curve of $\sigma^{1/2}$BHP versus thrust for the propeller configurations. $\sigma^{1/2}$ was based on atmospheric conditions at the time of test. Brake horsepower was obtained from engine curves based on RPM and manifold pressure for standard atmospheric conditions. Thrust calibration curves are shown in Figures 15 and 16.

7.2.2 Monoplane. The simulated semi-span wing used in this investigation had an aspect ratio of 1.67 (semi-span), no taper, and an NACA 0015 airfoil section. The wing was constructed of aluminum spars, stiffeners and skin and was mounted on a tubular metal framework which also served as a mount for the engine and propeller which were mounted below the wing. The wing incorporated two flaps with their leading edges at approximately the 38 and 44% chord, respectively. The flaps nested within the basic airfoil section when retracted and could be extended-deflected through a great number of angles in various combinations. Except for one test in the monoplane series the flap gaps were not sealed. Photographs of the model in several test configurations are shown in Figures 1 through 11.

7.2.3 Biplane. The simulated semi-span wings used in this investigation each had an aspect ratio of 2.64, no taper, and an NACA 0015 airfoil section. The wings were constructed of aluminum spars, stiffeners and skin

and mounted on the tubular metal framework of the monoplane tests. Each wing incorporated a double flap arrangement with the flap leading edges at approximately the 40 and 70% chord, respectively. The flaps nested within the basic airfoil section when retracted and can be extended-deflected in practically any combination for both wings. The flap gaps were not sealed for the biplane tests. Photographs of the model in several test configurations are shown in Figures 12 through 14.

7.2.4 Dimensional Data. The geometric characteristics of the models are given in the following table:

Monoplane Wing:

s = Area (semi-span), sq. ft.	48.51
b = Semi-span, ft.	9.00
c = Chord, ft.	5.34
Airfoil Section	NACA 0015
Aspect Ratio (semi-span)	1.67
Taper Ratio	1.00

Biplane Wings:

s = Area (two semi-spans), sq. ft.	61.50
b = Semi-span, ft.	9.00
c = Chord (each semi-span), ft.	3.417
Airfoil Section	NACA 0015
Aspect Ratio (each semi-span)	2.64
Taper Ratio	1.00

Propellers:

Hartzell Model	HC-83 x 20 - 1B/10133D
Blades	3
Diameter, ft.	8.458
Disk Area, sq. ft.	56.74
Hartzell Model	HC-12 x 20 - 8B/9333
Blades	2
Diameter, ft.	7.562
Disk Area, sq. ft.	44.89

Engine:

Lycoming Model	GO-435-C2
Cylinders (opposed).	6
Brake Horsepower at take-off	260
RPM at take-off	3400
Engine to propeller gear ratio	120:77
Compression ratio	7.3:1

7.3 Method of Recording Data. Two people read and recorded each of the gages of the balance system independently while two other people were independently reading and recording each of the appropriate engine instruments. The readings were then averaged (if a difference existed), and the average values were used in reducing the data. Figures 18 and 19 are sample data recording sheets.

7.4 Method of Reducing Data

7.4.1 Monoplane. A thrust calibration with the wing removed was conducted at the beginning of the test program to obtain a thrust versus power relationship for use in determining thrust values subsequently required for non-dimensionalizing lift and longitudinal force. In this calibration run, thrust was measured directly and power was obtained from engine RPM, manifold pressure, and atmospheric data. The results were plotted as thrust versus brake horsepower times the square root of the density ratio, since the general expression for static thrust involves (BHP) $\sigma^{1/2}$ as follows: (reference 1)

$$T = 10.42 \left[(FM)(D)(BHP)(\sigma^{1/2}) \right]^{\frac{2}{3}}$$

where

T = thrust, pounds

FM = figure of merit = $0.798\, C_T^{\frac{3}{2}} / C_p$

D = propeller diameter, feet

BHP = brake horsepower

σ = density ratio = ρ/ρ_o

C_T = thrust coefficient = $T/\rho n^2 D^4$

C_p = power coefficient = $P/\rho n^3 D^4$

P = power, ft.lbs./sec.

ρ = density, slugs/ft^3

n = propeller speed, RPS

To determine thrust for configurations with the wing in place, the calibration curve was entered at the $(BHP)\sigma^{-\frac{1}{2}}$ – value corresponding to measured engine power and atmospheric conditions.

Lift (L) was obtained from a summation of forces acting on the vertical cylinders as shown in the following equation:

$$L = 1.767\left[(F_7 + F_{11} + 2F_{12}) - (7 + 11 + 2\ 12)\right]$$

where

1.767 = Area of large end of load cylinder, square inches

3 = Dynamic reading of a specific gage connected to a specific cylinder as shown in the sketch at the bottom of Figure 18, pounds per square inch

F = Static or tare reading where subscript refers to a specific gage and cylinder combination, pounds per square inch

Longitudinal Force (LF) was obtained from a summation of forces acting on the horizontal cylinders as shown in the following equation:

$$LF = \left[1.767(10 + 8) - 1.571(4 + 2)\right] - \left[1.767(F_{10} + F_8) - 1.571(F_4 + F_2)\right]$$

where

1.571 = Area of small end of load cylinder, square inches

All other terms are the same as those in the lift equation.

Side Force was obtained from a summation of forces acting on the cylinder, orthogonally mounted with respect to the vertical and horizontal cylinders, as shown in the following equation:

$$SF = \left[1.571 (3) - 1.767 (9)\right] - \left[1.571\ F_3 - 1.767\ F_9\right]$$

where:

All terms are the same as those in the (L) and (LF) equations.

Pitching Moments (M) are determined about an axis passing through a point on the thrust line directly below the quarter chord line of the wing as shown in the following equation:

$$M = -\left[\frac{85.8 - (B + 16 \cos C)}{12}\right]\left[(F_{12} - (12))2\right] 1.767$$

$$+ \left[\frac{(B + 16 \cos C) - 6.15}{12}\right]\left[(F_{11} + F_7) - ((11) + (7))\right] 1.767$$

$$+ \left(\frac{85.3}{12}\right)\left\{\left[((10) + (8))\ 1.767 - ((4) + (2))\ 1.571\right] - \left[(F_{10} + F_8)\ 1.767\right.\right.$$

$$\left.\left. - (F_4 + F_2)\ 1.571\right]\right\}$$

where

B = Distance that leading edge of wing is behind the plane of the propeller, inches

C = Angle of incidence of the wing, degrees

All other terms are the same as those in the (L) and (LF) equations except the numerical values which are based on the dimensions shown in the sketch at the bottom of Figure 18.

Rolling Moments (ℓ) are determined about an axis parallel to and lying in the horizontal plane of the thrust line directly under the right hand tip of the wing by the following equation:

$$\ell = -1.767(F_{11} - 11)\left(\frac{28.25}{12}\right) + 1.767(F_7 - 7)\left(\frac{135.69}{12}\right)$$
$$- \left[(1.571\,3 - 1.767\,9) - (1.571\,F_3 - 1.767\,F_9)\right]\left(\frac{85.19}{12}\right)$$
$$+ 1.767\left[(F_{12} - 12)2\right]\left(\frac{54}{12}\right)$$

where

All terms are the same as those in the preceding equations.

Yawing Moments (N) are determined about an axis perpendicular to the horizontal plane of the thrust line and passing through the quarter chord line of the wing at the right hand tip by the following equation:

$$N = -\left[(1.767\,10 - 1.571\,4) - (1.767\,F_{10} - 1.571\,F_4)\right]\left(\frac{28.25}{12}\right)$$
$$+ \left[(1.767\,8 - 1.571\,2) - (1.767\,F_8 - 1.571\,F_2)\right]\left(\frac{135.69}{12}\right)$$
$$+ \left[(1.571\,3 - 1.767\,9) - (1.571\,F_3 - 1.767\,F_9)\right]\left(\frac{B + 16\cos C - 3.47}{12}\right)$$

where

All terms are the same as those in the preceding equations.

The pitching moment coefficient was obtained from the following equation:

$$C_m = \frac{M}{q'' c S}$$

where

C_m = pitching moment coefficient

M = pitching moment in foot pounds about an axis passing through a point on the thrust line directly below the quarter chord line of the wing

q'' = dynamic pressure in the slipstream = $\frac{4T}{\pi D^2}$, pounds per square foot

D = propeller diameter, feet

c = wing chord, feet

S = wing area, square feet

T = propeller thrust, lbs.

The yawing moment coefficient was obtained from the following equation:

$$C_n = \frac{N}{q'' S\, b}$$

where

C_n = yawing moment coefficient

N = yawing moment in foot pounds about an axis through the quarter chord line at the right hand tip of the wing (looking from behind) and perpendicular to the plane of thrust

b = wing span, feet

The rolling moment coefficient was obtained from the following equation:

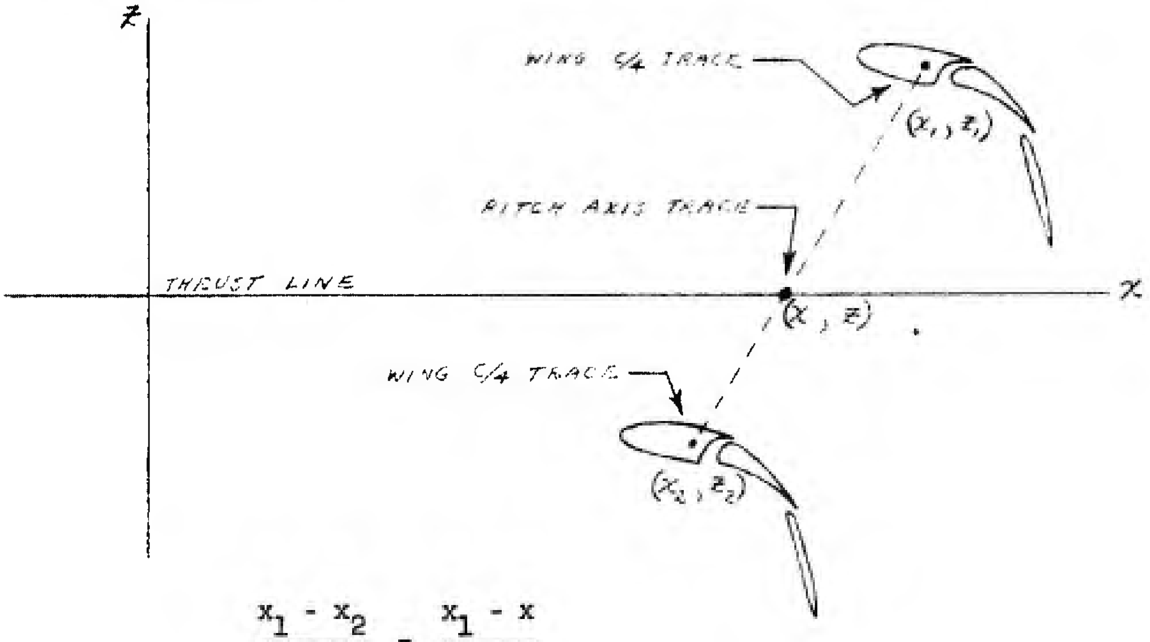
$$C_\ell = \frac{\ell}{q'' S\, b}$$

where

C_ℓ = rolling moment coefficient

ℓ = rolling moment in foot pounds about an axis parallel to and lying in the horizontal plane of the thrust axis at the right hand tip of the wing

7.4.2 Biplane. The method of reducing the data for the biplane type apparatus is the same as for the monoplane except that the pitching and yawing moments have been computed about different reference axes. The following sketch and equations show how the pitching moment reference axis was determined:



$$\frac{x_1 - x_2}{z_1 - z_2} = \frac{x_1 - x}{z_1 - z}$$

let z = 0

$$x = -\left(\frac{x_1 - x_2}{z_1 - z_2}\right) z_1 + x_1$$

Yawing moment for the biplane was taken about an axis perpendicular to the horizontal plane of thrust at the right hand wing tip on a line parallel to the wing C/4 line passing through the intersection of the thrust line and a line drawn between the C/4 lines of each wing.

Rolling moment was calculated in the same manner for the monoplane and biplane configurations.

8.0 DISCUSSION

8.1 Accuracy of Results. In general, the accuracy and repeatability of the test results are considered satisfactory. Tare readings exhibited very small errors which in most instances amounted to less than 1%. The propeller calibration used for data reduction was checked near the mid-point of the test program and found to be essentially the same. Some scatter appears in the test data; however, it is felt that it will have no influence on the general conclusions to be drawn from the results. The test apparatus and balance system were mounted out of doors subject to any wind at the time of test. The physical aspects of the test location indicated that a quartering wind from the right (looking forward) would predominate. These winds would tend to transmit an off-the-thrust-line force to the balance system, thereby complicating the measurement of side force, roll and yaw. The magnitudes of wind effects were not ascertained, but they are believed to be small.

8.2 Thrust

8.2.1 Propeller Configuration. Prior to the investigation with the wing (or wings) in place, a three-bladed and two-bladed propeller were run on the test apparatus to determine available thrust and optimum blade angle (measured at the 0.75 blade length station). Several blade angles were checked on both propellers. Based on a propeller load analysis curve, the three-blade propeller with a blade angle of 8.9 degrees was considered to be a reasonable configuration for the tests. The two-bladed propeller

was used only for purposes of comparison; consequently, no great importance may be attached to these results. Figures 15 and 16 present propeller thrust in terms of the product of brake horsepower and square root of the density ratio. Figure 20 presents comparative data of the two propellers with a wing attached. The results indicate insignificant differences in the resultant-thrust ratio between the propellers and approximately two degrees less turning angle for the three-bladed propeller.

8.2.2 Interference. The test apparatus was located in the test area such that the propeller disk was approximately 7 feet from a solid panel fence, and the first test run was made under this condition. To determine the effects of the fence, the second run was made with the fence removed. The data plotted in Figure 21 indicate that the fence caused unwanted influences on turning angle and pitching and rolling moment coefficients; consequently, subsequent tests were made with the fence removed.

8.3 Resultant Force and Turning Angle

8.3.1 Monoplane

8.3.1.1 Flap Deflection Combinations

8.3.1.1.1 Ground Plane Removed. A number of tests were conducted without the ground plane in place to determine the optimum angles of deflection for the forward and aft flaps as regards resultant force and turning angle. A sufficient number of runs were made to show comparative results. Figure 22 presents data with both flaps nested within the basic airfoil

section and with both flaps at various deflection angles. The results indicate that with both flaps deflected 30°, the resultant-thrust ratio and turning angle are approximately 0.82 and 49°, respectively. The combination of 45° forward flap and 30° aft flap shows a resultant-thrust ratio of approximately 0.79 with a corresponding turn angle of approximately 59°. Further deflection of the aft flap shows a marked decrease in the resultant-thrust ratio while the turn angle increases only slightly.

8.3.1.1.2 Ground Plane Installed. The effects of the proximity of the ground are illustrated in Figures 23, 24, 25 and 26 for various flap deflection combinations. In general, the results show that the presence of the ground plane increases the resultant-thrust ratio and turning angle and causes a nose-down pitching tendency when flap deflections of 45° forward flap and 40° aft flap, or less, are used. The combination of 30° forward and aft flap deflection shows a resultant-thrust ratio of approximately 0.95 with a turning angle of approximately 59° when in the presence of ground effects; however, this reduces to approximately 0.82 and 49°, respectively, when ground effects are removed.

Figures 27 through 31 present additional data in the presence of the ground plane with various forward and aft flap deflections. The combination of 30° forward and aft flap deflection shows the highest resultant-thrust ratio of approximately 0.95 with a corresponding turn angle of approximately 59°. The combination of 45° forward flap and 30° aft flap deflection appears to give the largest turn angle, approximately 66°, with a relatively high corresponding resultant-thrust ratio of approximately 0.82.

Figures 32, 33 and 34 present data on the effect of changing the gap between wing and forward flap. The use of a reasonable slot opening between the wing and flap appears to give a slight increase in resultant-thrust ratio, as compared to the gap-sealed condition.

Figure 35 presents the data obtained from retracting the flaps in a typical take-off sequence. The ground plane was installed and no attempt was made to simulate leaving ground effects other than increasing the distance from the trailing edge of the aft flap to the ground plane as a result of flap retraction. The changes in the parameters with varying flap deflections appear to be smooth. No regions of erratic forces or moments are indicated.

8.3.1.2 Wing Location. Several tests were conducted to explore the effects of wing location with relation to the thrust axis and propeller plane. Limited data in the absence of ground effects are shown in Figure 36. From examination of these results it appears that immersing the wing well in the slipstream is very beneficial in producing high resultant-thrust ratios. With the ground plane installed, however, it appears that moving the thrust axis downward with respect to the wing increases the positive pressure region under the wing, thereby increasing resultant-thrust ratios. This trend is shown in Figures 37 and 38.

8.3.1.3 Auxiliary Devices

8.3.1.3.1 End Plates. In an attempt to increase positive pressures on the under surfaces of the wing, end plates were installed. As seen by

the data presented in Figure 39, the resultant-thrust ratio and turning angle appear to be insensitive to end plates. Additional results regarding end plate effects are shown in Figures 40 and 41 and appear to show only the effects of the large flap deflection angles and ground plane.

8.3.1.3.2 Auxiliary Vanes. In order to improve turning angles, several auxiliary vane configurations were tested. These vanes are shown in sketches 1 through 5 of Figure 17. The results are presented in Figures 42, 43, 44, 45 and 46. The vane configuration of Figure 42 (sketch 1, Figure 17) gave a resultant-thrust ratio of approximately 0.91 with a corresponding turn angle of approximately 61°. Direct comparison with other vane configurations would be unrealistic due to changes in flap deflection and/or ground effects. In general, it appears that the vanes increased the turning angle but had an adverse effect on the resultant-thrust ratio.

The vane configurations of Figure 47 (sketches 6, 7, 8, 9, and 10 of Figure 17) show the results of placing a vane ahead of the wing for the purpose of pitching control. The results tend to corroborate the evidence obtained from the vanes tested for turning aids in that the addition of the vane has lowered the resultant-thrust ratio and increased the turning angle.

A vane was mounted above the engine nacelle and perpendicular to the horizontal plane as shown in the sketch on Figure 48. The results indicate that the various parameters are relatively unaffected by vane deflections for this configuration.

8.3.1.3.3 Aft Flap Hinged at Mid-Chord. Several tests were conducted with the aft flap hinged along the mid-chord line to explore this means of achieving control. The results shown in Figure 49 indicate that, as regards resultant force, variations of tab angle from neutral appear to cause significant reductions in resultant-thrust ratio. Turning angle seems to exhibit a trend with varying tab deflection, although the results for the tab neutral condition appear to be out of line with the other data.

8.3.1.3.4 Spoiler. A full-span, flap-type, slot-lip spoiler was installed on the upper surface of the wing to investigate this type of control. The influence of this device on resultant-thrust ratio and turning angle is detrimental as shown by the data of Figure 50.

8.3.2 Biplane

8.3.2.1 Flap Deflection Combinations

8.3.2.1.1 Ground Plane Removed. As in the case of the monoplane tests, a series of tests were conducted with the ground plane removed to determine optimum flap deflection angles as regards resultant force and turning angle. In the absence of the ground plane and at upper and lower wing incidence settings of 20° and 5°, respectively, the data presented in Figure 51 indicate that resultant-thrust ratio and turning angle appear insensitive to flap deflection combinations. The resultant-thrust ratio is approximately 0.88 with an approximate turning angle of 54°. Figure 52 presents the data obtained from inverting the wing combination on the test apparatus to simulate the ground plane at an infinite distance.

Again the resultant-thrust ratio and turning angle appear relatively insensitive to flap deflection combinations. The resultant-thrust ratio is approximately 0.82 with an approximate turning angle of 53°. The lower values with an infinite distance ground plane seem to indicate that an unanticipated ground influence may be present when testing in the normal position.

8.3.2.1.2 Ground Plane Installed. Figure 53 presents comparative data for gound plane installed and ground plane removed, and Figure 54 shows the differences occuring between results with the ground plane installed and inverting the wing combination on the test apparatus to simulate the ground at an infinite distance. The resultant-thrust ratio for the ground plane installed is approximately 0.95 with a corresponding turn angle of approximately 58°.

The effects of upper wing flap deflection are presented in Figure 55 through 69. A resultant-thrust ratio of 1.01 with a corresponding turn angle of 58° was measured in the presence of the ground plane with an upper wing incidence of 20°, the upper wing forward and aft flaps at 40° and 37°, respectively, a lower wing incidence of 5°, and the lower wing forward and aft flaps at 40° and 37°, respectively. The maximum turning angle appears to have been reached at the same point as the maximum resultant-thrust ratio.

The effects of lower wing flap deflection are presented in Figures 70 through 74. Again a maximum resultant-thrust ratio of approximately 1.01 was achieved. The corresponding turn angle is approximately 55° with

an upper wing incidence of 20° with the upper wing forward and aft flaps at 42.5° and 40.5°, respectively, and lower wing incidence of 7.5° with the lower wing forward and aft flaps at 30° and 21.5°, respectively. A maximum turn angle of approximately 61° with a corresponding resultant-thrust ratio of approximately 0.92 occurs with an upper wing incidence of 20° with the upper wing forward and aft flaps at 42.5° and 40.5°, respectively, and a lower wing incidence of 10°, with the lower wing forward and aft flaps at 45° and 44°, respectively, and in the presence of the ground plane.

The results of deflecting the upper and lower wing-flaps progressively are presented in Figures 75 and 76. It is seen that the best configuration of this survey gave a resultant-thrust ratio of approximately 0.97 with a corresponding turn angle of approximately 58°.

8.3.2.2 Wing Location

8.3.2.2.1 Angle of Incidence. The upper wing was tested at several angles of incidence with the lower wing at fixed incidence and flap setting. The test data are presented in Figure 77. Under the conditions imposed, the optimum angle of incidence as regards resultant-thrust ratio and turning angle for the upper wing appears to be between 20° and 25°. An inspection of Figure 77 reveals that the turn angle increases steadily as upper wing incidence increases until 20° is attained. The next data point shows a relatively large drop in the resultant-thrust ratio with a small gain in turning angle. This tendency is exhibited for all of the configurations tested.

The lower wing was also tested at various angles of incidence with the upper wing at fixed incidence and flap setting. The test data are presented in Figure 78. Under the conditions imposed, the optimum angle of incidence as regards resultant-thrust ratio and turning angle for the lower wing appears to be approximately 7.5°; however, no comparable test data are available for incidence settings less than 7.5°. The results of this figure indicate that the resultant-thrust ratio decreased as the lower wing incidence was increased for each configuration tested while the turning angle was essentially unaffected.

8.3.2.2.2 Gap/Chord Ratio. Several tests were conducted with various vertical distances between the wings. This gap (the vertical distance) divided by the chord is the Gap/Chord Ratio. The results of these tests are shown in Figures 79 and 80 and indicate that the resultant-thrust ratio is relatively insensitive to a change in the gap when large flap deflections are used.

8.3.2.2.3 Stagger/Chord Ratio. Several tests were conducted with the wings at various amounts of stagger. Stagger is equal to the horizontal distance between the leading edge of the upper wing and the leading edge of the lower wing. Negative stagger occurs when the upper wing leading edge is aft of the lower wing leading edge. The results of these tests are shown in Figures 81 and 82 and indicate that a Stagger/Chord ratio of approximately -1.24 is near optimum for this wing and flap configuration. The resultant-thrust ratio and turning angle appear to increase as the stagger/chord ratio approaches -1.24, and decreases between -1.24 and -1.82.

8.3.2.2.4 Gap/Chord and Stagger/Chord Ratio. The effects of changing the Gap/Chord and Stagger/Chord ratios progressively are presented in Figure 83. The results of this figure show that when the gap is decreased and the stagger increased negatively, there is a large increase in the resultant-thrust ratio (0.80 to 0.95) and turning angle (48° to 58°) for the wing and flap configuration of these tests. Due to the scope of data, the limits of change are not defined.

8.3.2.3 Auxiliary Vane. The effects of an auxiliary vane mounted above and ahead of the upper wing are presented in Figure 84. The resultant-thrust ratio and turning angle increase with increasing vane incidence angle. The maximum values occur at a vane angle of incidence of approximately 20°. Figure 85 presents a comparison of vane-on and -off and indicates that the resultant-thrust ratio is comparatively sensitive to vane incidence changes. However, only the vane incidence angle of approximately 20° gives results comparable to the no-vane configuration.

8.4 Controllability Considerations

8.4.1 Monoplane

8.4.1.1 Auxiliary Vanes. Several tests were conducted with an auxiliary vane mounted above and ahead of the wing to study this device as a possible means of control. The principal results of these tests are presented in Figures 86, 87 and 88. Pitching moment appears to be affected only slifhtly by a change in vane angle of incidence. Yawing and rolling moments appear to be relatively unaffected by this vane configuration.

A vane mounted perpendicular to the horizontal plane of thrust and extending above the wing was tested at several deflections to the right and left of the line of thrust. Figures 89, 90 and 91 present the results. The perpendicular vane, as tested, appears to have essentially no effect on the pitching and yawing moments and very little effect on the rolling moment.

8.4.1.2 Aft Flap Hinged at Mid-Chord. A series of tests were conducted with the aft flap hinged about its mid-chord line as shown in sketches 11, 12, 13 and 14 of Figure 17 to determine primarily the pitching control exerted by flap-tab deflection. The results are presented in Figures 92, 93 and 94 and indicate that an angular displacement of the tab appears to have little effect on any of the moments.

8.4.1.3 Spoiler. A full-span, flap-type, slot-lip spoiler was installed on the upper surface of the wing as shown in sketch 15 of Figure 17. This spoiler was tested at several angular deflections for purposes of aerodynamic control evaluation and the results are presented in Figures 95, 96 and 97. Pitching and yawing moments appear to be affected very little. The rolling-moment coefficient reduces as the spoiler deflection angle increases; however, the amount of change in rolling moment is moderate over the range of spoiler deflections.

8.4.2 Biplane

8.4.2.1 Auxiliary Vane. An auxiliary vane was mounted above and ahead of the upper wing to determine the pitching control exerted. Figures

98, 99 and 100 present the results obtained in these tests. The data seem to exhibit quite a bit of scatter; however, the pitching moment appears to reduce slightly as a function of vane angle of incidence. Yawing and rolling moments appear to be affected only slightly by a change in vane angle of incidence.

9.0 CONCLUSIONS

A resultant-thrust ratio of approximately 0.99 with a corresponding slipstream turning angle of approximately 60° was measured in the presence of a ground plane with the monoplane apparatus. These values reduce to approximately 0.83 and 49°, respectively, when the ground plane is removed.

The largest slipstream turning angle obtained with the monoplane apparatus was approximately 71° with a corresponding resultant-thrust ratio of approximately 0.76 in the presence of a ground plane. These values reduce to approximately 67° and 0.69, respectively, when the ground plane is removed.

A resultant-thrust ratio of approximately 1.01 with a corresponding slipstream turning angle of approximately 58° was measured in the presence of a ground plane with the biplane apparatus.

The largest slipstream turning angle obtained with the biplane apparatus was approximately 61° with a corresponding resultant-thrust ratio of approximately 0.92 in the presence of a ground plane.

The resultant-thrust ratio and slipstream turning angle appear to be reduced by approximately 0.08 and 5°, respectively, when the ground plane is removed from the biplane configuration.

Auxiliary vanes which were installed on both the monoplane and biplane configurations to assist in turning the slipstream, exhibited a similar tendency of increasing the turning angle but reducing the resultant-thrust ratio.

Pitching moment measurements indicate that a significant nose-up moment change results when the ground plane is removed or when the flaps are retracted.

Rolling and yawing moments appear to remain essentially unaffected when the ground plane is removed or when the flaps are retracted.

Auxiliary vanes, which were tested as means of achieving control, gave relatively small moment changes for relatively large vane-position variations and vane angle of incidence changes.

The aft flap was hinged at its mid-chord to explore the characteristics of a more or less conventional-type control device. This scheme was rather ineffective in producing moment changes. A full-span, flap-type, slot-lip spoiler was rather ineffective in producing significant pitching and yawing moment changes although rolling moments are moderately affected.

10.0 REFERENCES

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2. Kuhn, Richard E. and Draper, John W.: "An Investigation of a Wing-Propeller Configuration Employing Large-Chord Plain Flaps on Large-Diameter Propellers for Low-Speed Flight and Vertical Take-Off", NACA TN-3307 dated December 1954.

3. Kuhn, Richard E. and Draper, John W.: "Some Effects of Propeller Operation and Location on Ability of a Wing with Plain Flaps to Deflect Propeller Slipstreams Downward for Vertical Take-Off", NACA TN-3360 dated January 1955.

4. Kuhn, Richard E. and Draper, John W.: "Investigation of the Aerodynamic Characteristics of a Model Wing-Propeller Combination and of the Wing and Propeller Separately at Angles of Attack up to 90°", NACA TN-3304 dated November 1954.

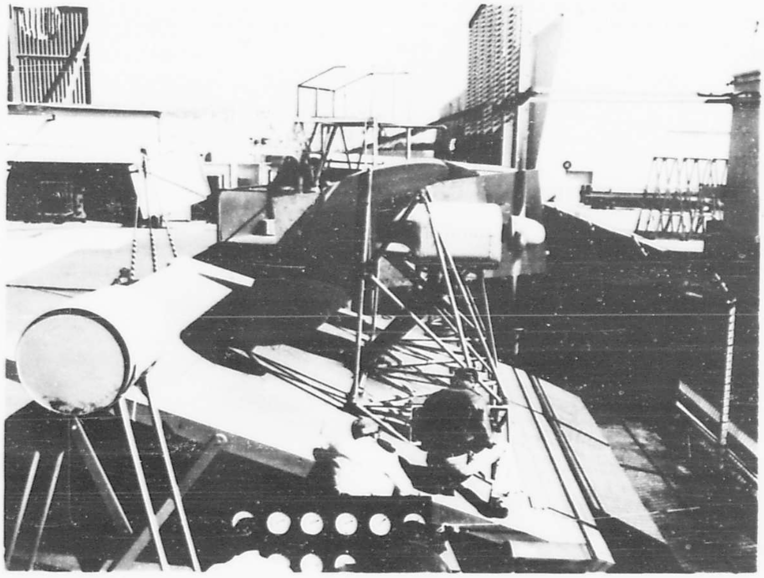


Figure 1

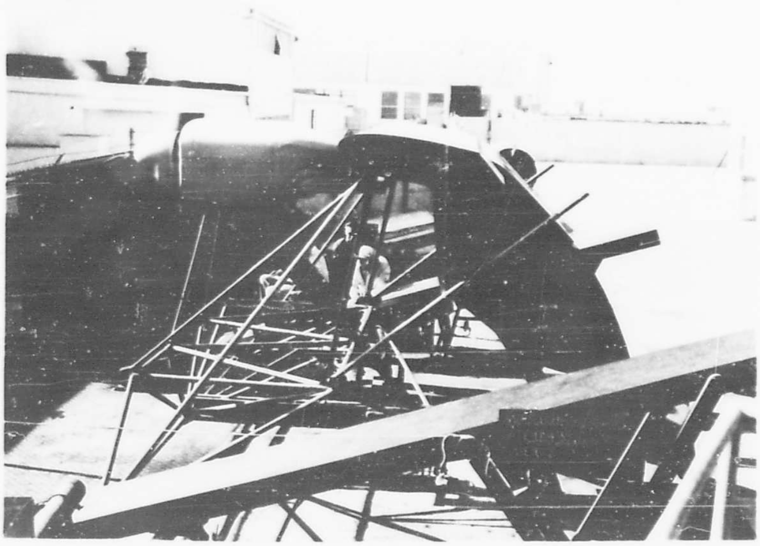


Figure 2

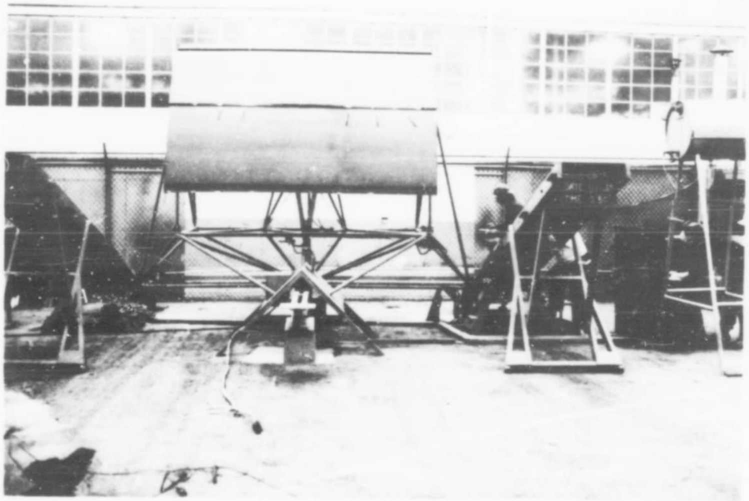


Figure 3

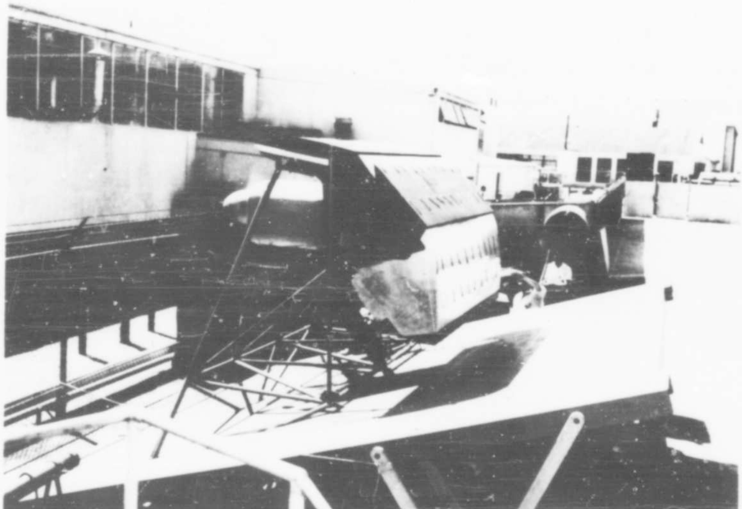


Figure 4

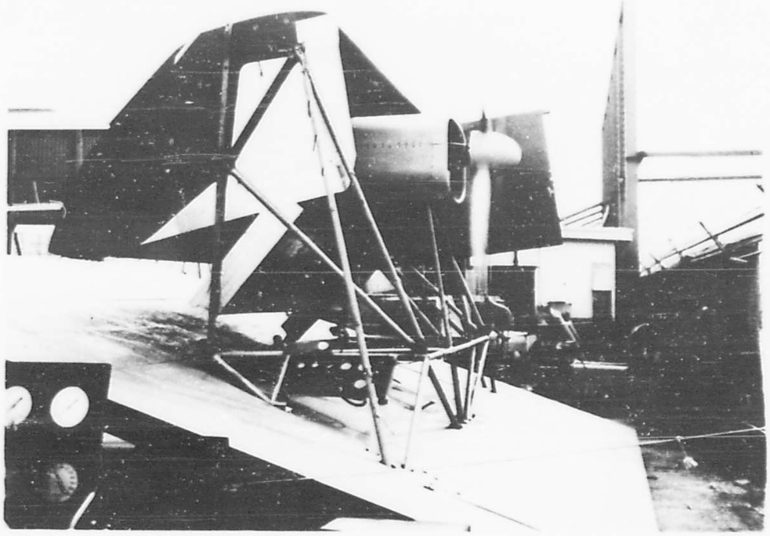
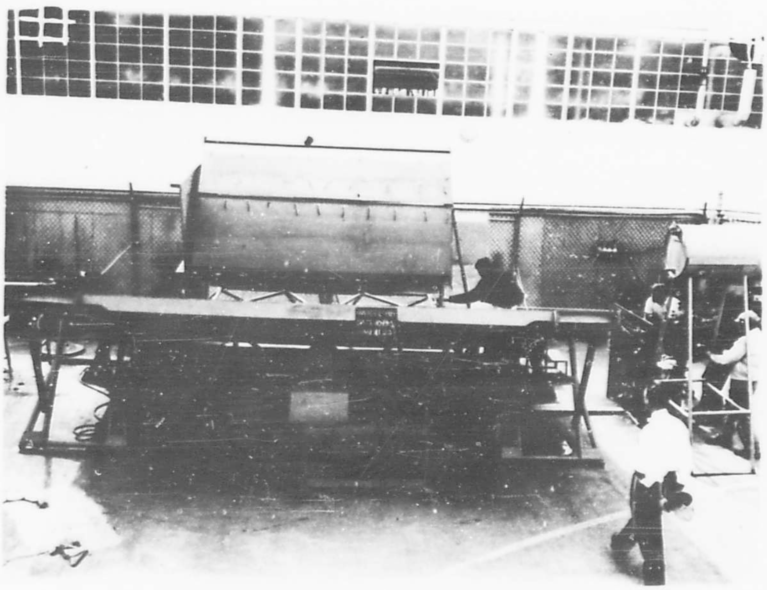


Figure 5



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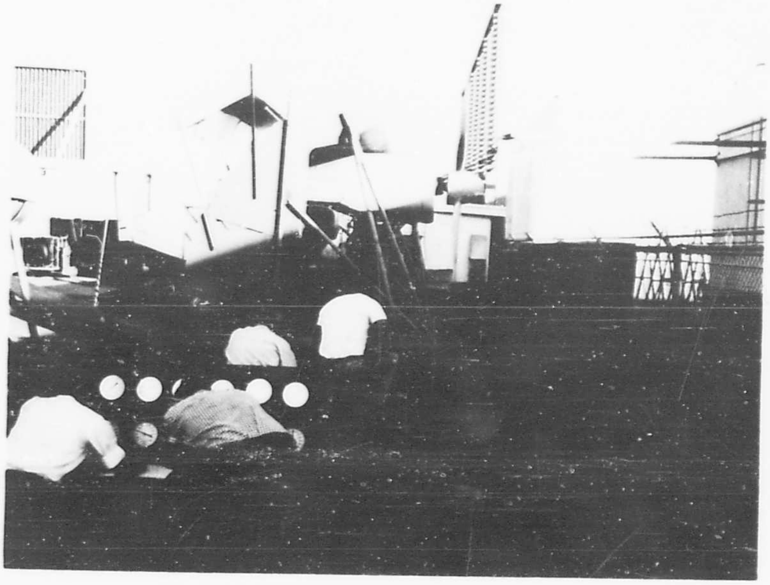

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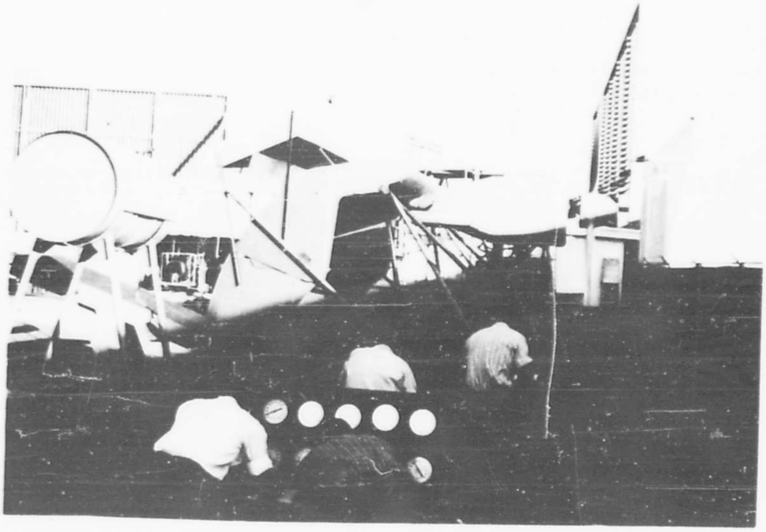

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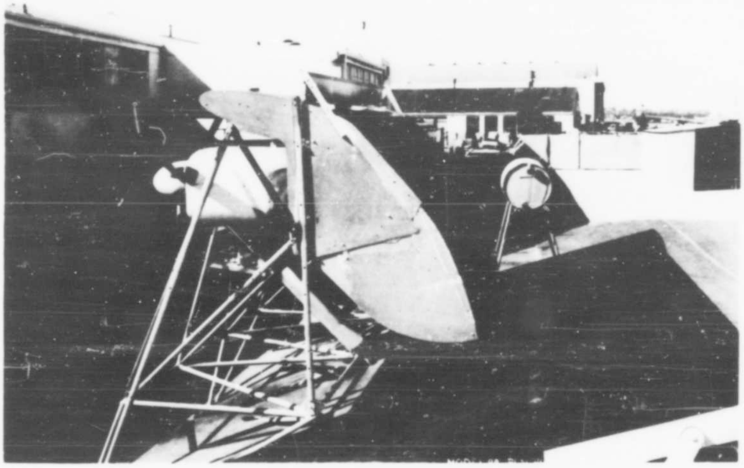


Figure 9

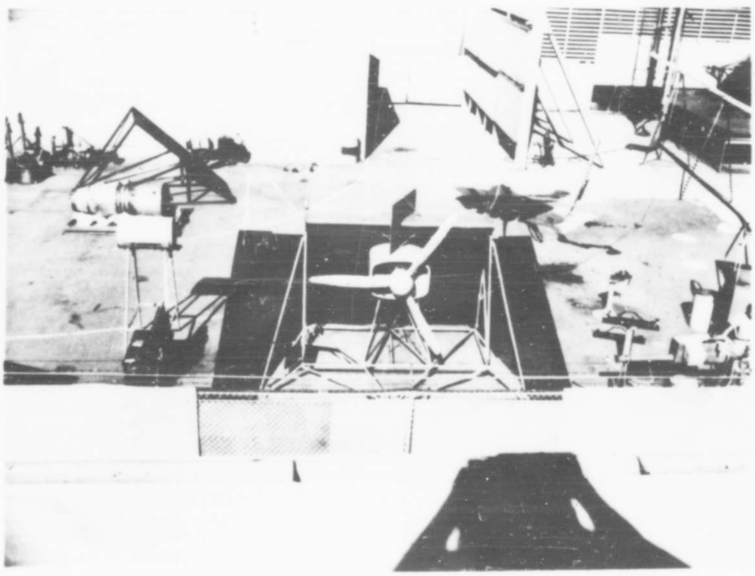


Figure 10

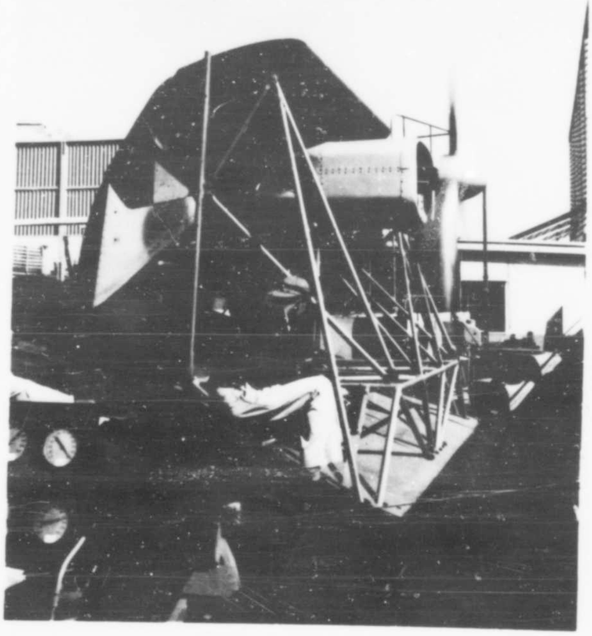


Figure 11

Figure 12

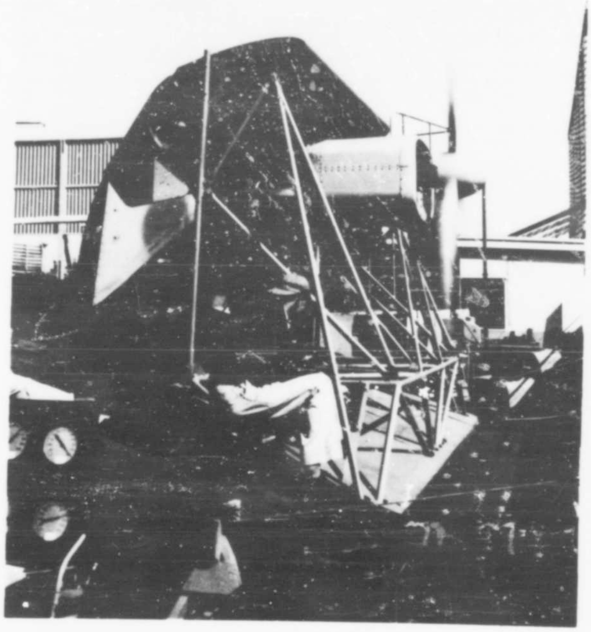


Figure 11

Figure 12

Figure 13

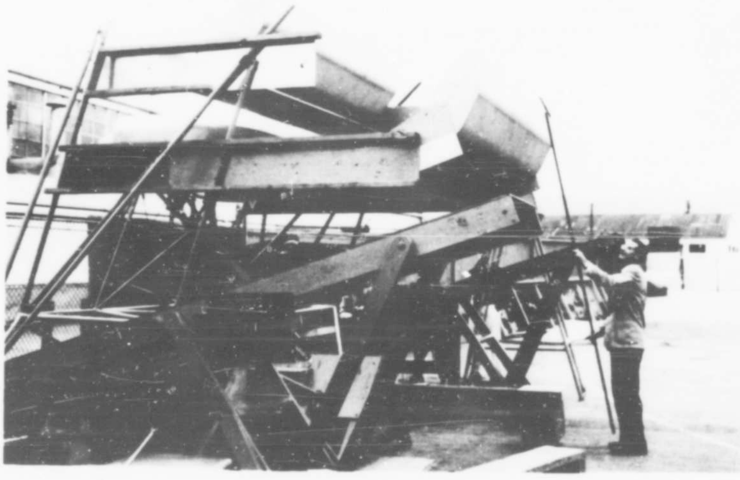


Figure 14

Figure 15

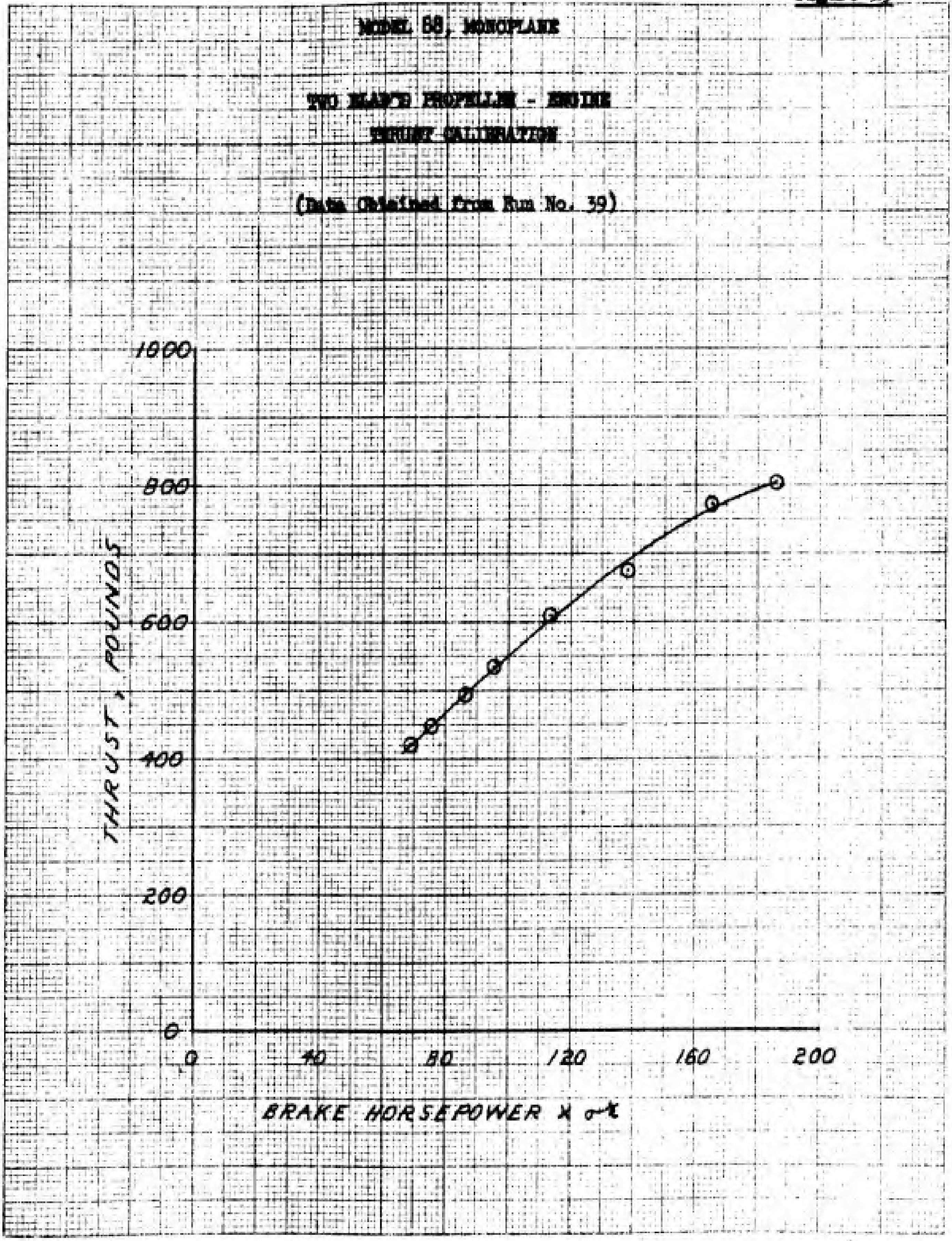
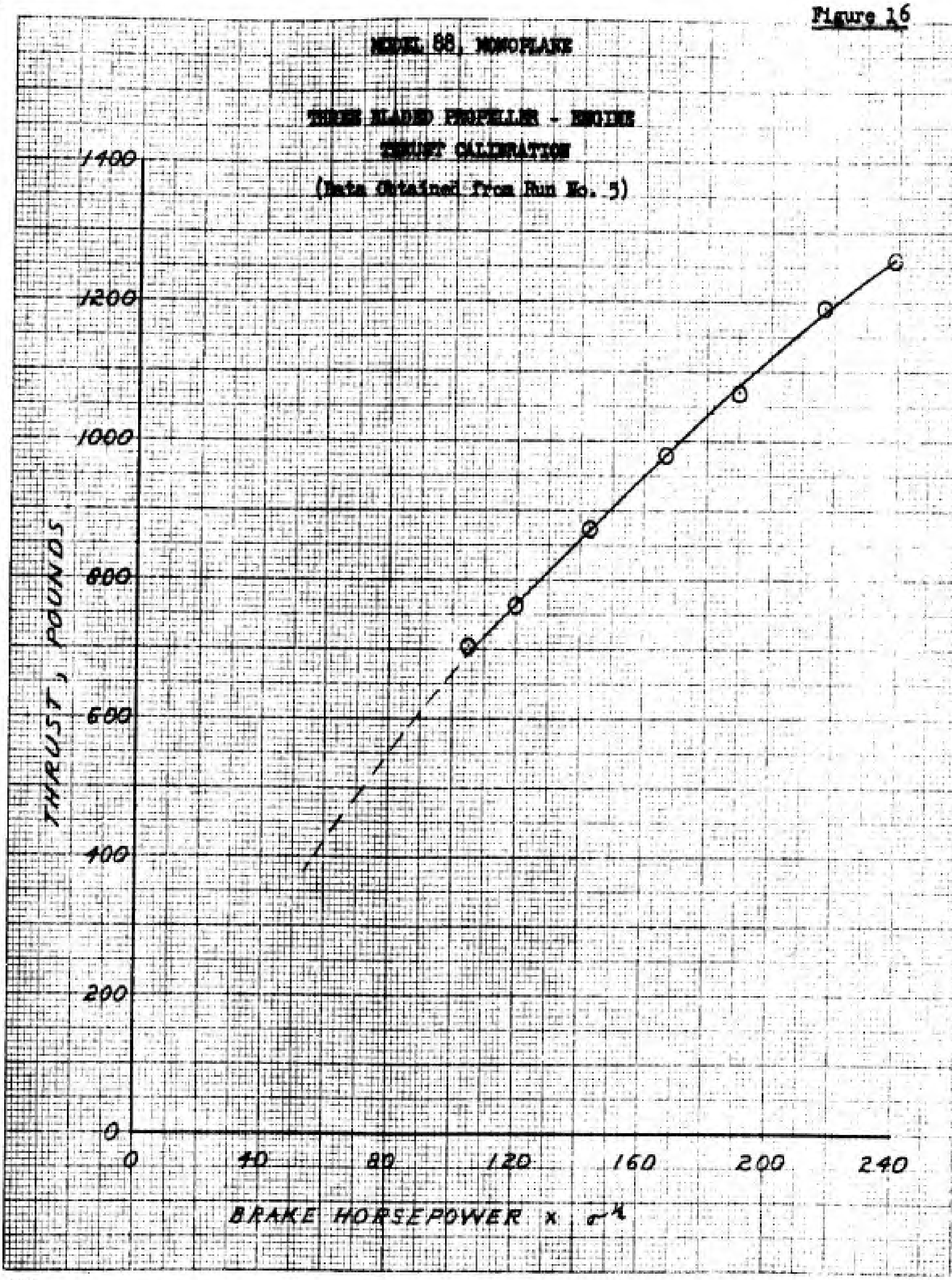
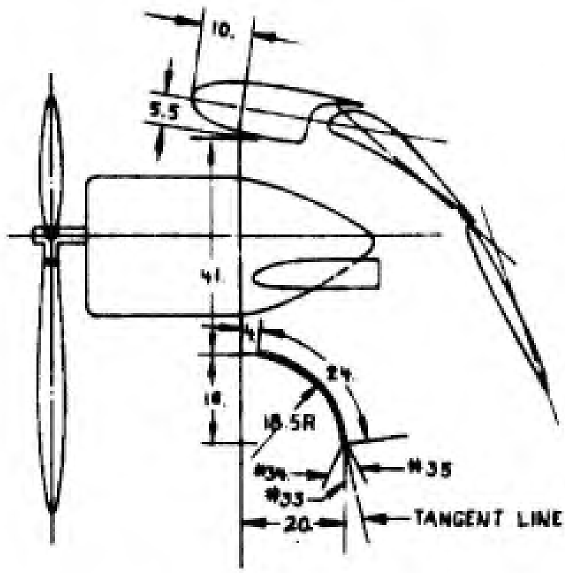

MODEL 88, MONOPLANE
TWO BLADE PROPELLER - ENGINE
THRUST CALIBRATION
(Data Obtained from Run No. 39)
1000
800
600
400
200
0
THRUST, POUNDS
0
40
80
120
160
200
BRAKE HORSEPOWER

Figure 16

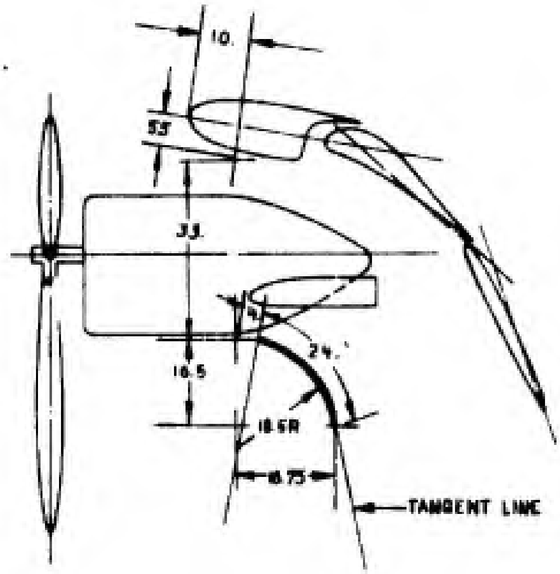

MODEL 88, MONOPLANE
THREE BLADED PROPELLER - ENGINE
THRUST CALIBRATION
(Data Obtained from Run No. 5)
1400
1200
1000
800
600
400
200
0
THRUST, POUNDS
0
40
80
120
160
200
240
BRAKE HORSEPOWER x $\sigma^{-1/2}$

SKETCHES OF AUXILIARY VANES

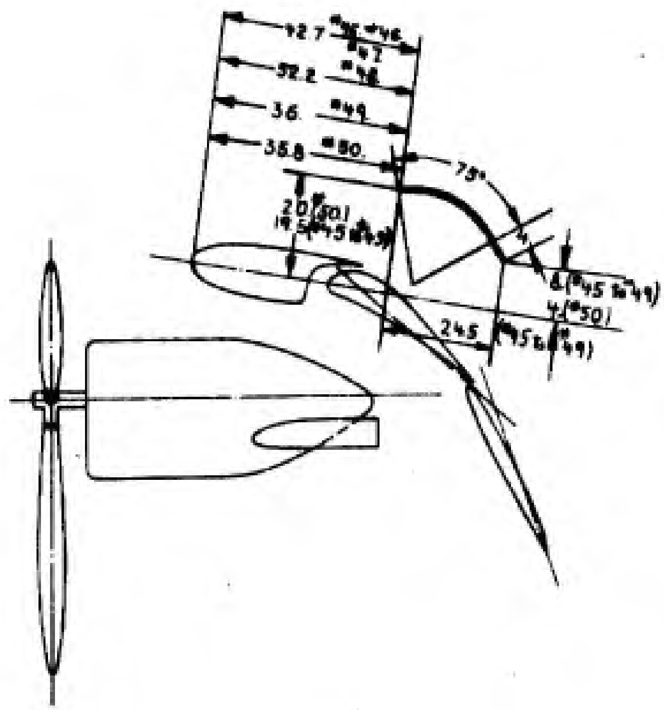
Figure 17



Sketch 1



Sketch 2



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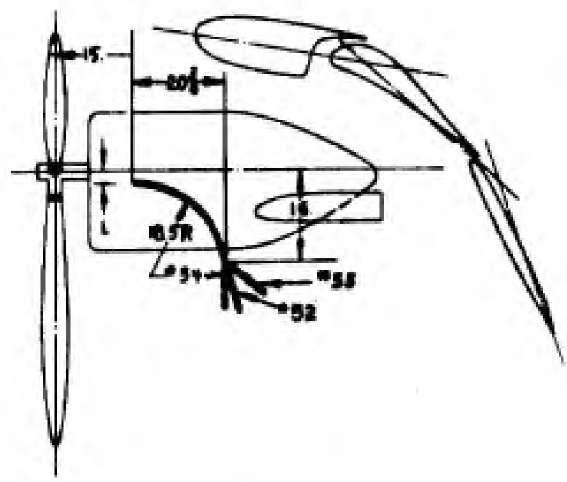
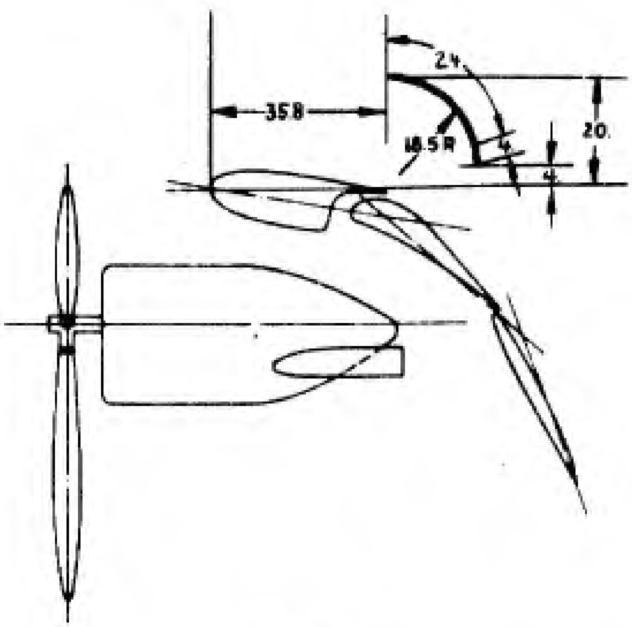


Sketch 4

SKETCHES OF AUXILIARY VANES

Figure 17



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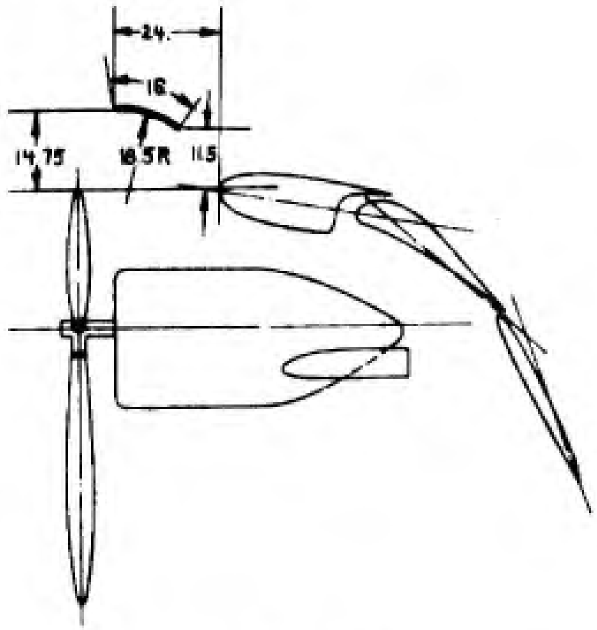

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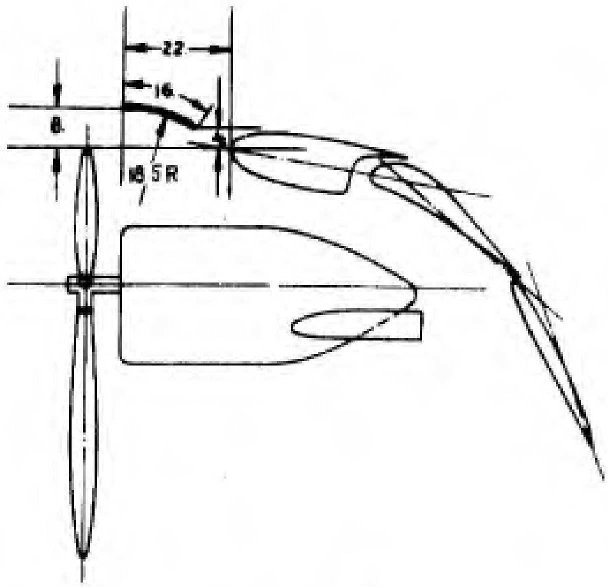

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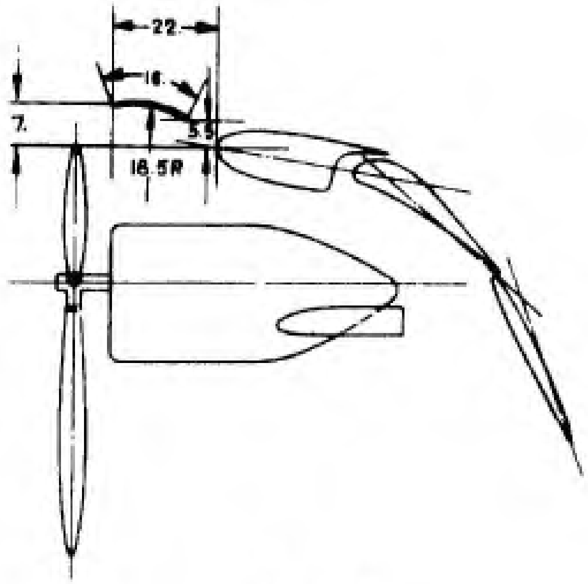
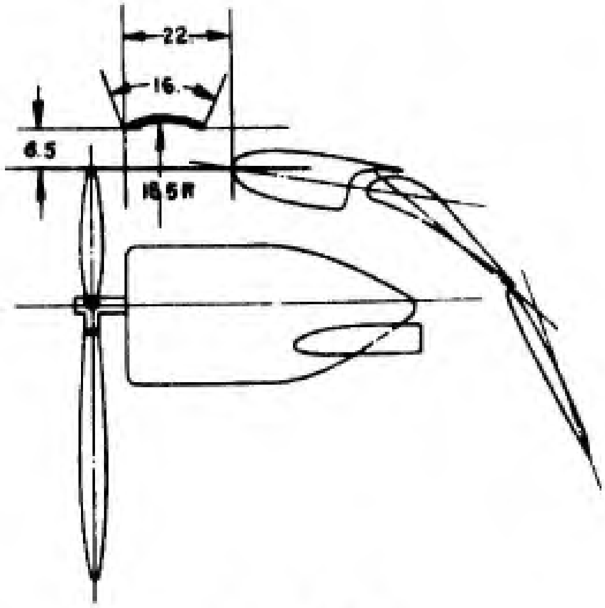


Sketch 8

SKETCHES OF AUXILIARY VANES

Figure 17



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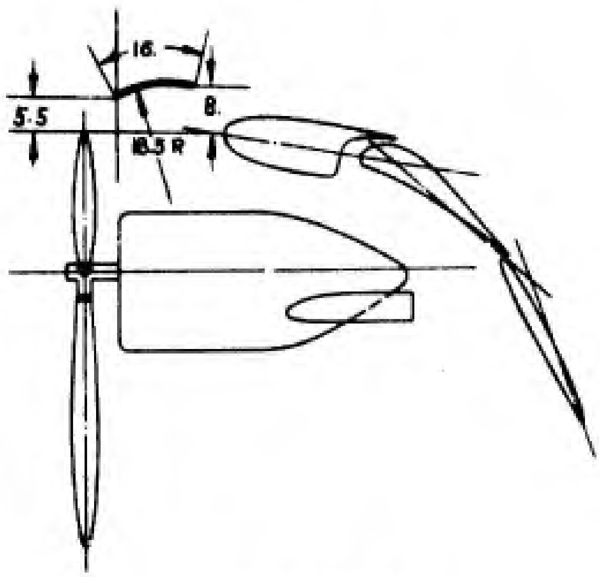
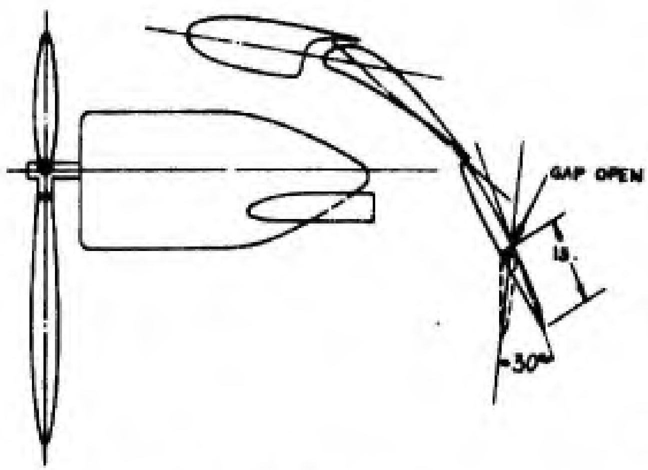


Sketch 10

SKETCHES OF CONTROL TABS



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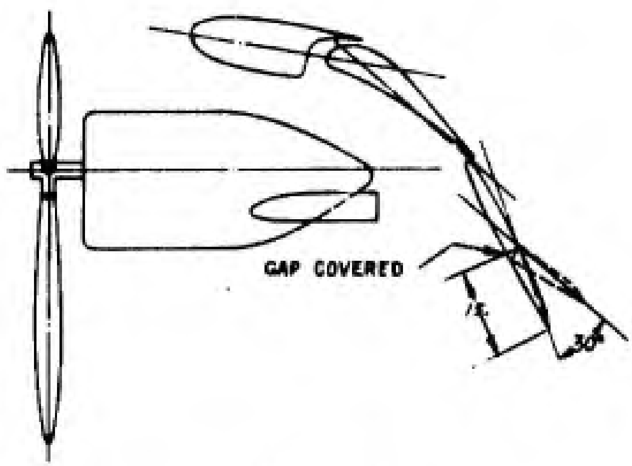
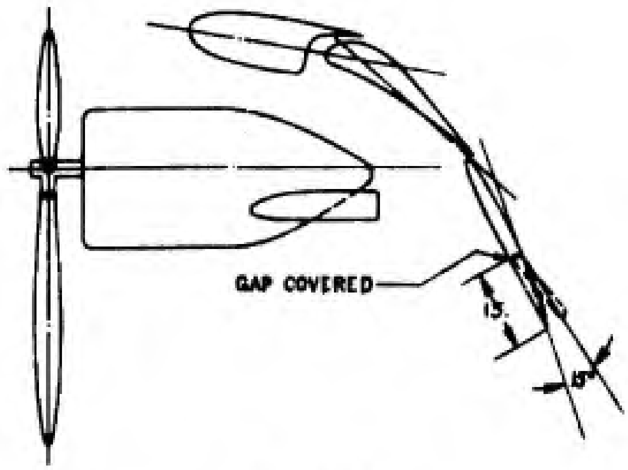


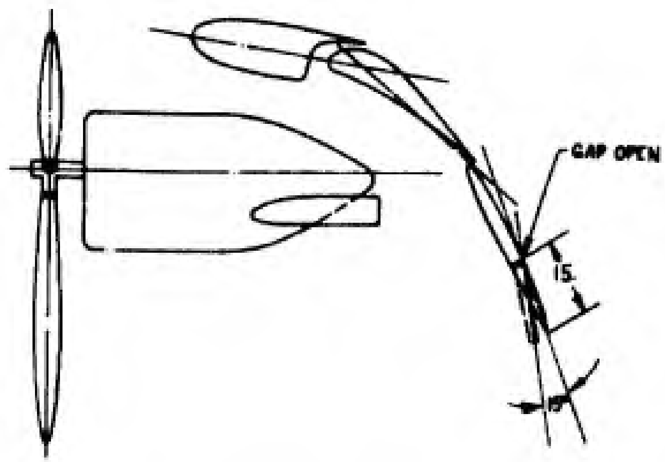
Sketch 12

SKETCHES OF CONTROL TABS

Figure 17



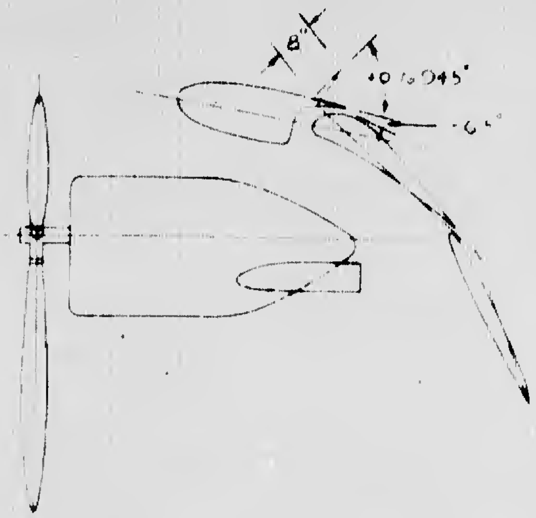
Sketch 13



Sketch 14

Figure 17

Sketches of Auxiliary Control Devices



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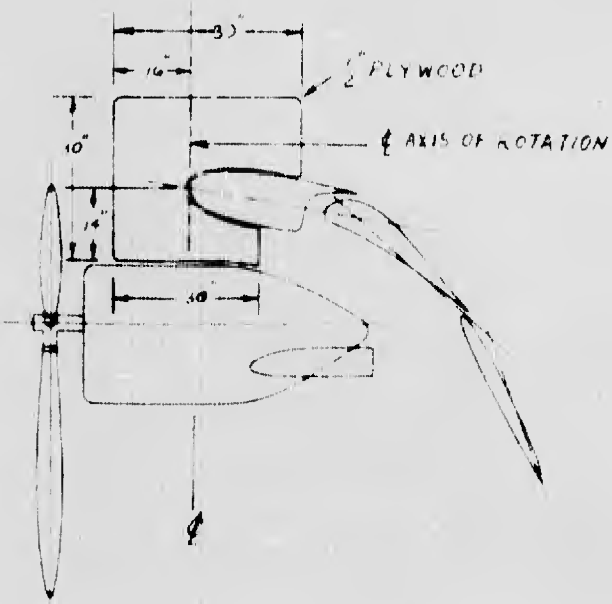
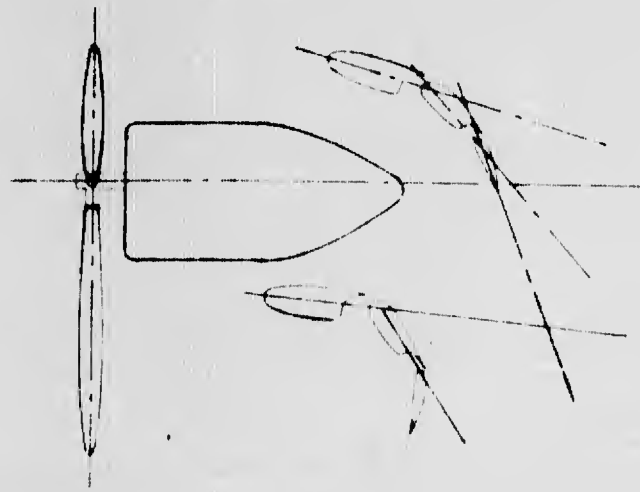


Sketch 16

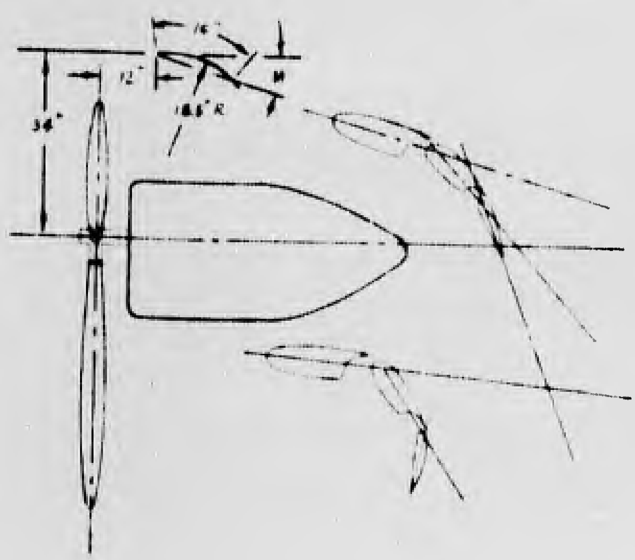
Sketch of Biplane Configuration

Figure 17



Sketch 17

Sketch of Auxiliary Vane

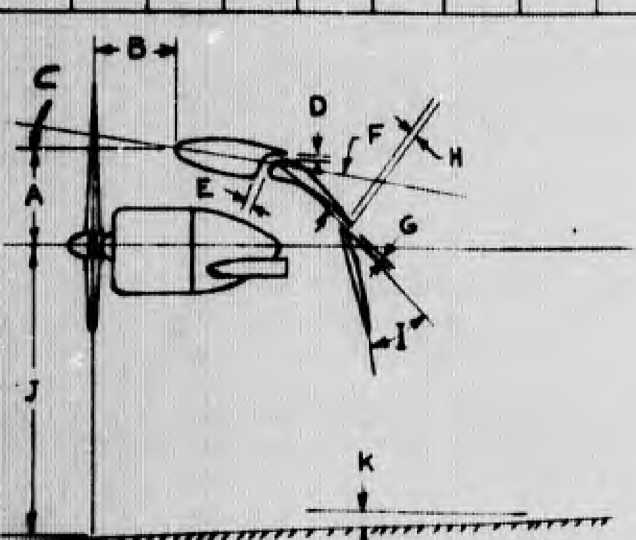


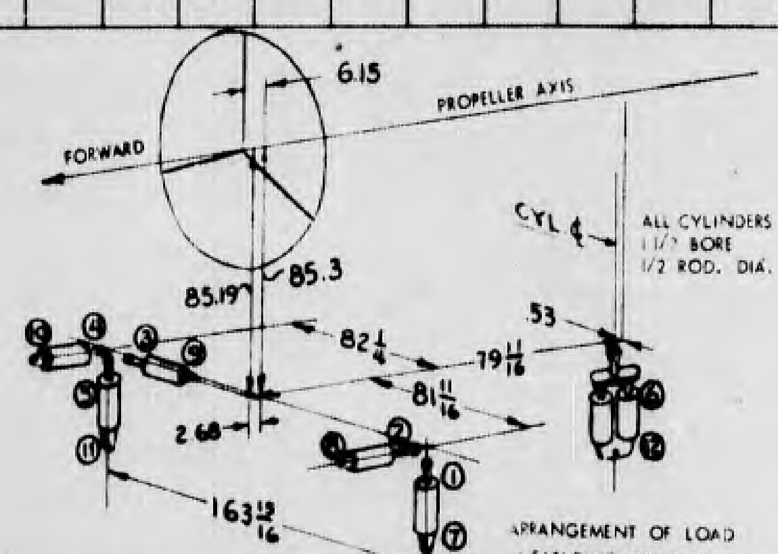
Sketch 18

Figure 18

MODEL 88 TEST DATA

Run No.	Date	Time	Wind Velocity	Wind Direction	Air Temp. Deg. C	Barometric Pressure	Humidity	Engine R.P.M.	Torque Meter	Manifold Pressure	Cyl. Head Temp. °C	Load Cylinder Gage Readings (Lbs./Sq. In., Gage) 1	2	3	4	5	6	7	8	9	10	11	12	Wing Setting A	B	C	Flap Settings Fwd. D	E	F	Aft G	H	I	Ground Plane J	K	Prop. Blade Angle	Additional Remarks
45	11/7	3:30	4	N.W.	25°	29.95		2805	162.5 166.5	22.38	190°	0	53	57	53	0	0	314	176	89	163	285	223													*See Sketch Below Showing Turning Vane
		3:32						2935	200 204	24.85	225	0	55	60	55	0	0	330	193	97	180	299	172													Above Wing
												-	63.5	67.5	64	-	-	116	58.5	66	54	124.5	605.5													x = 5.55"
46	11/8	3:29	3	N.W.	25°	30.09		2815	168.5 171.5	22.8	210°	0	54	59	54	0	0	242	152	78	147	223	302	18	26	13°	.9	5.9	35	.9	.4	35°				*Entire Wing and Turning Vane Assem.
		3:31						2900	193.5 197	24.5	230°	0	55	60	55	0	0	250	160	85	156	228	278	18												Moved Up and Forward From Previous Posi-
		3:33						2995	224 228	26.4	245°	0	55	60	55	0	0	253	170	88	159	228	255													tion
													62.5	66	62			158.5	57	62	56	170.5	563.5													x = 14.88"
47	11/9	1:21	5-6	N.W.	24.5°	29.95		2805	164 167	22.4	205°	0	54	59	54	0	0	245	153	73	149	221	318	26	29	13°	.9	5.9	35	.9	.4	35°				*Entire Wing and Turning Vane Assem.
		1:23						2912	194.5 198	24.5	230°	0	55	60	55	0	0	253	161	85	155	224	293													Moved Up and Aft From Previous Posi-
		1:26						2975	223 227	26.5	245°	0	55	60	55	0	0	261	175	86	165	228	270													tion
												-	64	68	64.5	-	-	158.5	58	63.5	58.5	170	573													x = 22.378"
48	11/10	10:48	0	--	23.5°	29.79		2810	161.5 164	22.1	205°	0	54	59	54	0	0	234	160	81	149	210	320													Same as Previous Run Except 42" Distance
		10:50						2900	183 185.5	23.4	230°	0	55	60	55	0	0	241	169	82	160	220	301													to L.E. of Vane Increased to 52.2.
		10:52						3010	217 220	25.6	245°	0	55	60	55	0	0	248	180	81	163	219	271													x = 22.378"
		10:54						3100	252.5 256	28.28	255°	0	55	60	55	0	0	265	193	91	182	229	239													(Full Throttle)
												-	64.5	67.5	65	-	-	155	60	63.5	59	169	570.5													





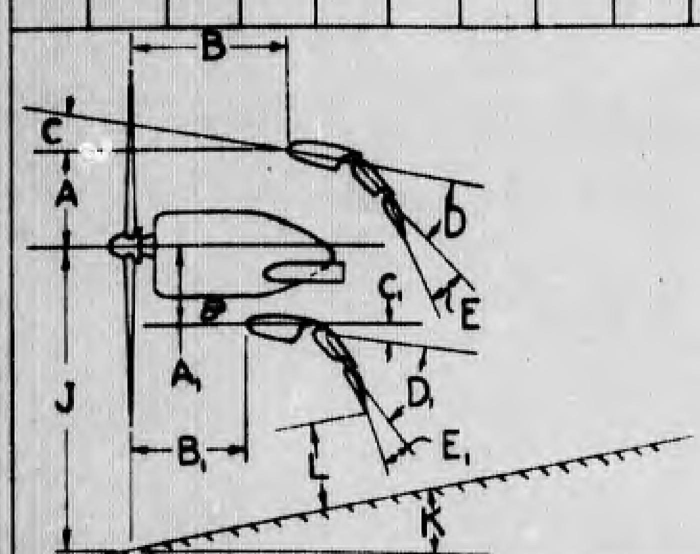
NOTES

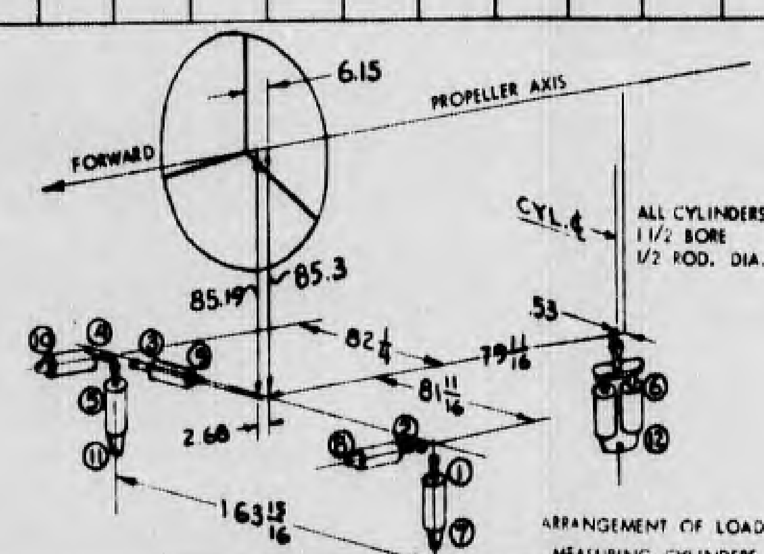
Figure 19

MODEL 88 TEST DATA

RUN NO.	DATE	TIME	WING VELOCITY	WIND DIRECTION	AIR TEMP. DEG. C	BAROMETRIC PRESSURE	HUMIDITY	ENGINE R.P.M.	TORQUE METER	MANIFOLD PRESSURE	CYL. HEAD TEMP. °C	LOAD CYLINDER GAGE READINGS (LBS./SQ. IN., GAGE) 1	2	3	4	5	6	7	8	9	10	11	12
B1.1	12/27	11:26			17.0	30.01		2900	202	25.05	200	0	54	57	55	0	0	390	265	74	255	355	180
B1.2	"	11:29			"	"		2900	200	24.85	220	0	54	58	55	0	0	370	242	70	242	340	200
B1.3	"	11:32			"	"		2905	199.5	24.75	225	0	55	59	56	0	0	340	225	70	222	312	221
B1.4	"	11:35			"	"		2905	201	24.93	245	0	55	59	56	0	0	324	213	72	204	292	227
B1.5	"	11:38			"	"		2920	202	24.90	245	0	55	59	56	0	0	318	211	75	204	290	242
TARE	"				"	"						0	62	66	65	0	0	165	58.5	60	57	174	549
B2.1	"				16.0	29.99		2895	192.5	24.10	190	0	52	57	54	0	0	381	256	70	250	346	192
B2.2	"				"	"		2925	202	24.75	210	0	55	59	56	0	0	369	249	73	250	332	197
B2.3	"				"	"		2915	202	24.83	225	0	55	59	56	0	0	344	232	73	226	310	215
B2.4	"				"	"		2930	203	24.80	240	0	55	60	57	0	0	323	222	74	212	294	227
B2.5	"				"	"		2930	199.5	24.50	245	0	55	60	57	0	0	305	205	75	205	279	245
TARE	"				"	"						0	62.5	66	65.5	0	0	169	60	58	58.5	177.5	552.5
B3.1	12/28				12.5	30.06		2930	198.5	24.35	190	0	52	56	54	0	0	384	264	60	259	363	190
B3.2	"				"	"		2910	194.5	24.10	215	0	54	58	55	0	0	356	244	64	240	334	211
B3.3	"				"	"		2915	197.5	24.30	235	0	55	59	56	0	0	336	230	67	225	310	218
B3.4	"				"	"		2908	199	24.50	245	0	55	60	56	0	0	311	211	68	206	282	239
B3.5	"				"	"		2900	203	25.00	255	0	55	60	56	0	0	298	202	68	198	275	249
B3.6	"				"	"		2920	202.5	24.80	255	0	55	60	56	0	0	290	190	68	182	261	269
TARE	"				"	"						0	64	69	66	0	0	172.5	55.5	59	61	182.5	552.5

RUN NO.	DESCRIPTION OF APPARATUS AND TEST CONFIGURATION: UPPER WING A	B	C	D	E	LOWER WING A_1	B_1	C_1	D_1	E_1	GROUND PLANE J	K	L	PRO-PELLER DATA	ADDITIONAL REMARKS
B1.1	23.5	49.3	5°	35°	29°	21.5	37	5°	50°		79.5	18.5	7.25		
B1.2	23.5	49.3	5°	40°	37°	21.5	37	5°	50°	51°	79.5	18.5	7.25	8.9°	
B1.3	23.5	49.3	5°	45°	44°	21.5	37	5°	50°	51°	79.5	18.5	7.25	75%R	
B1.4	23.5	49.3	5°	50°	51°	21.5	37	5°	50°	51°	79.5	18.5	7.25		
B1.5	23.5	49.3	5°	55°	[illegible]	21.5	37	5°	50°	51°	79.5	18.5	7.25	8.458′	
TARE															
B2.1	23.5	49.5	10°	30°	21°	21.5	37	5°	50°	51°	79.5	18.5	7.25		
B2.2	23.5	49.5	10°	35°	29°	21.5	37	5°	50°	51°	79.5	18.5	7.25		
B2.3	23.5	49.5	10°	40°	37°	21.5	37	5°	50°	51°	79.5	18.5	7.25		
B2.4	23.5	49.5	10°	45°	44°	21.5	37	5°	50°	51°	79.5	18.5	7.25		
B2.5	23.5	49.5	10°	50°	51°	21.5	37	5°	50°	51°	79.5	18.5	7.25		
TARE															
B3.1	23.5	50.2	25°	20°	8°	21.5	37°	5°	50°	51°	79.5	18.5	7.25		
B3.2	23.5	50.2	25°	25°	14.5°	21.5	37°	5°	50°	51°	79.5	18.5	7.25		
B3.3	23.5	50.2	25°	30°	21°	21.5	37°	5°	50°	51°	79.5	18.5	7.25		
B3.4	23.5	50.2	25°	35°	29°	21.5	37°	5°	50°	51°	79.5	18.5	7.25		
B3.5	23.5	50.2	25°	40°	37°	21.5	37°	5°	50°	51°	79.5	18.5	7.25		
B3.6	23.5	50.2	25°	45	44°	21.5	37°	5°	50°	51°	79.5	18.5	7.25		
TARE															





NOTES

Figure 20

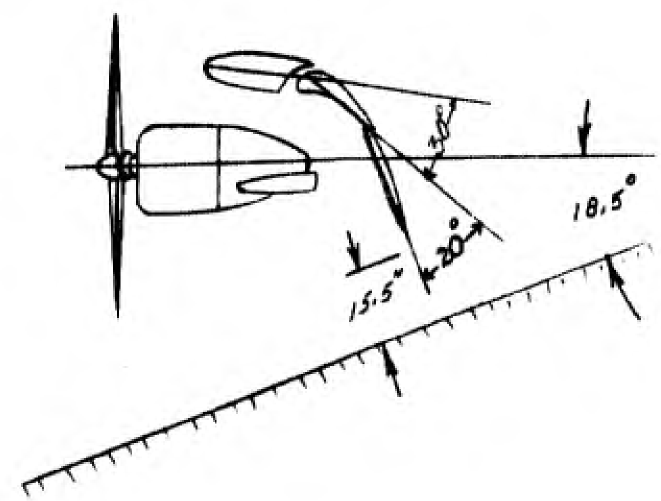
MODEL 88 MONOPLANE CONFIGURATION

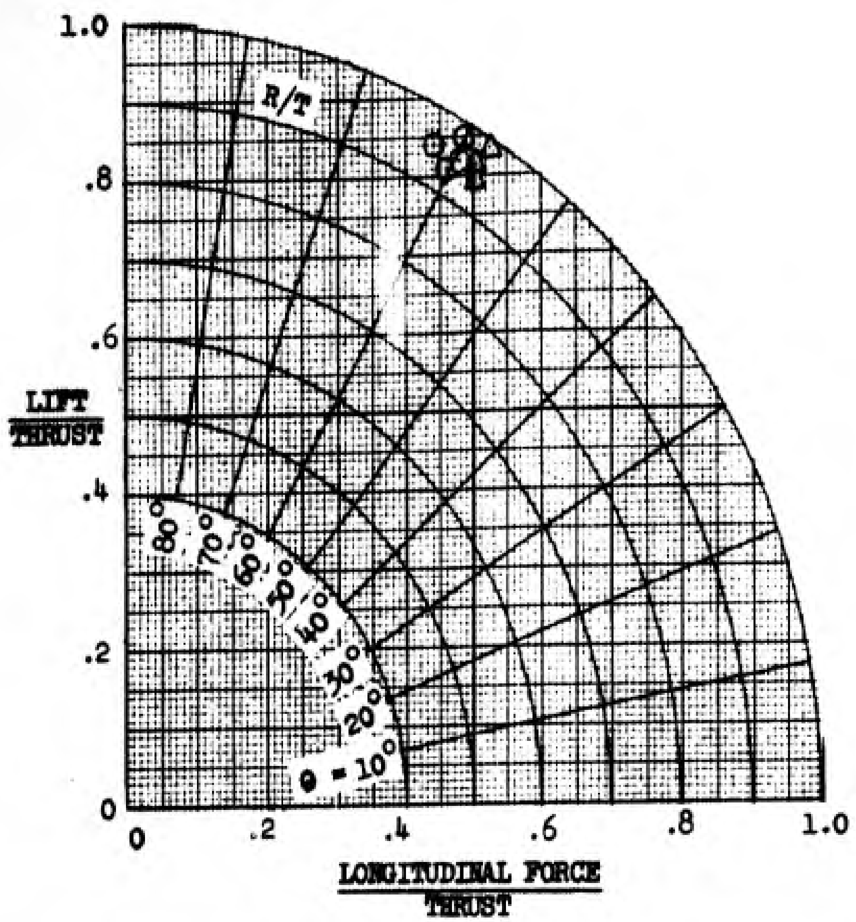
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

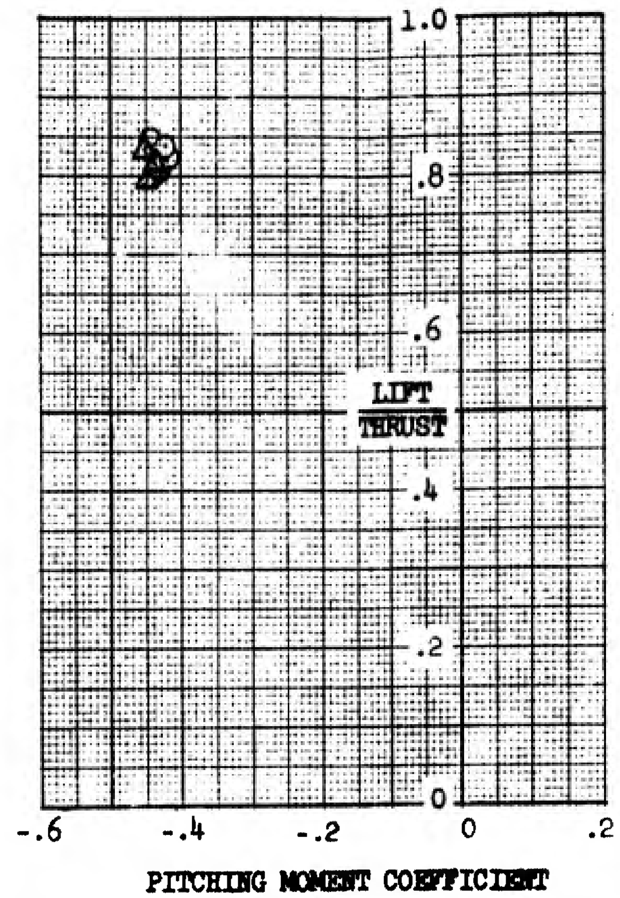
Effect of Two Propellers With 30° Forward Flap Deflection

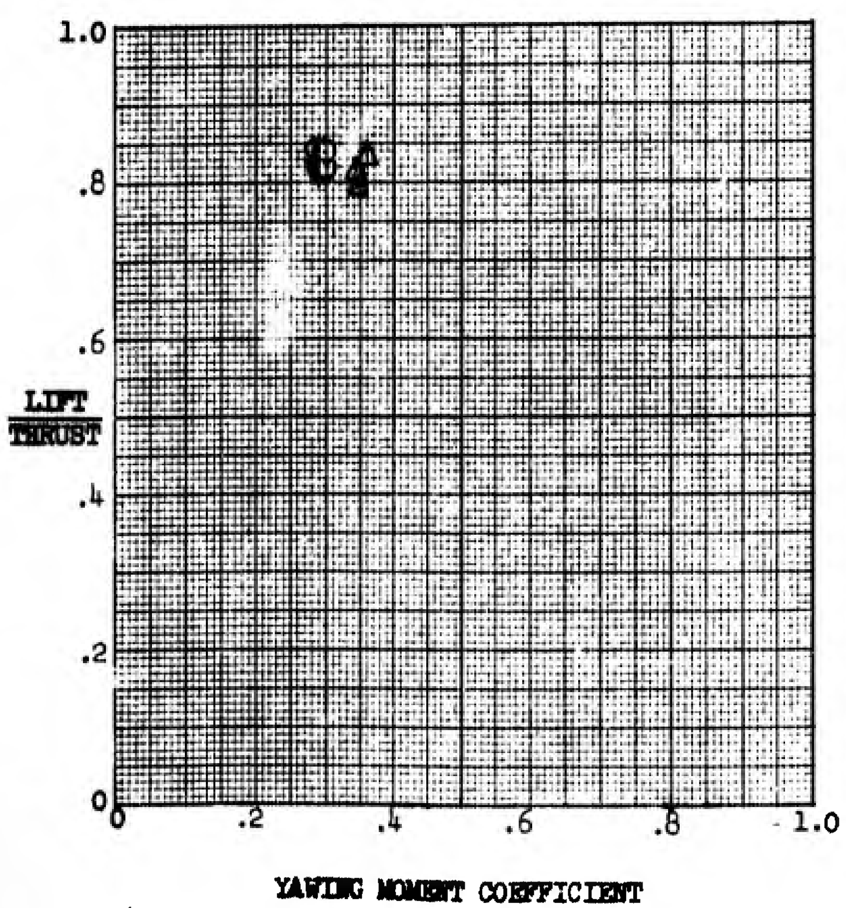
And 20° Aft Flap Deflection, Ground Plane Installed

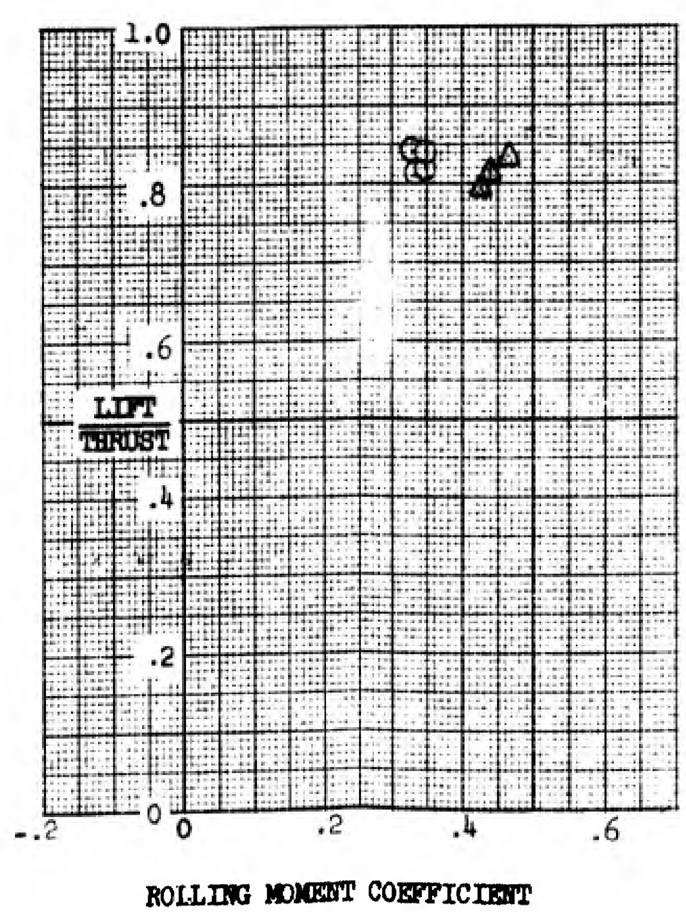
SYM	RUN	BLADES
○	58	2
△	59	3

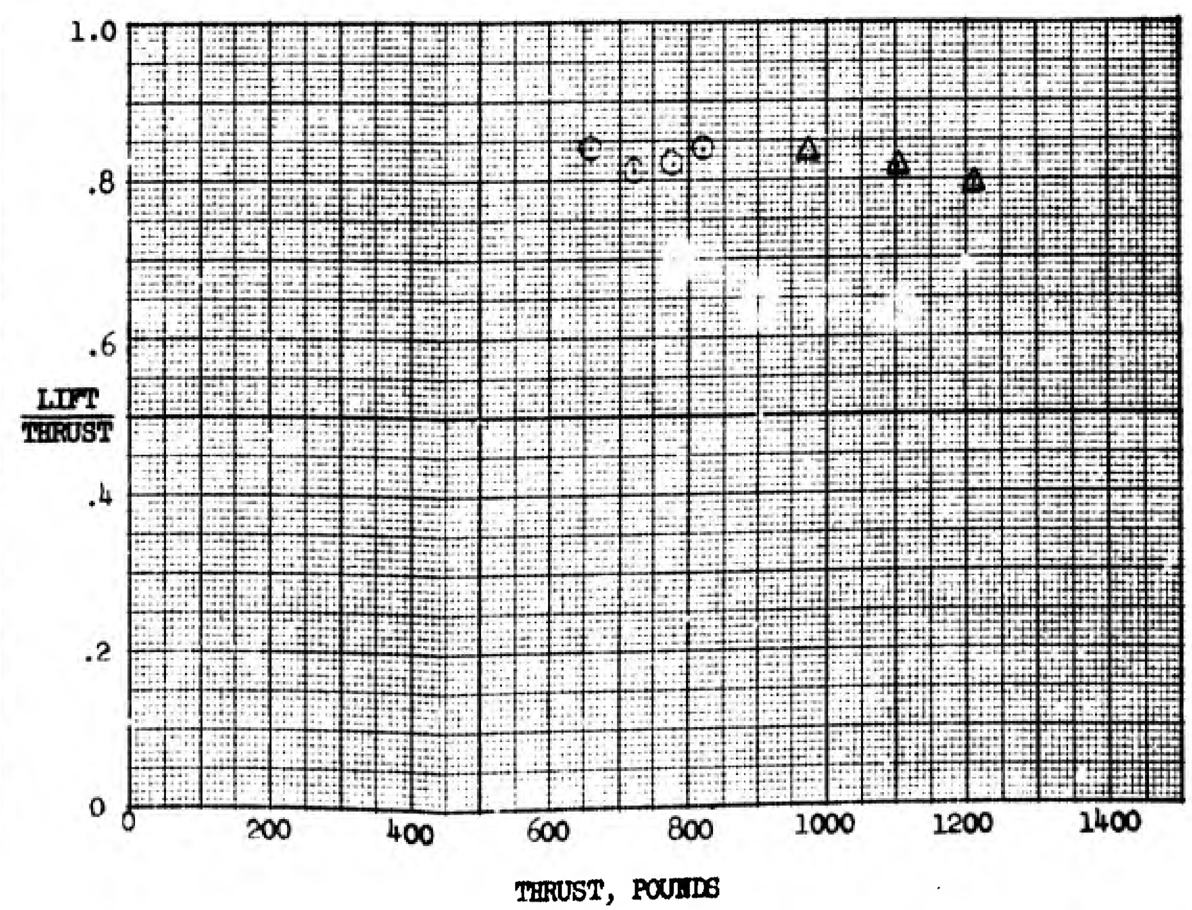












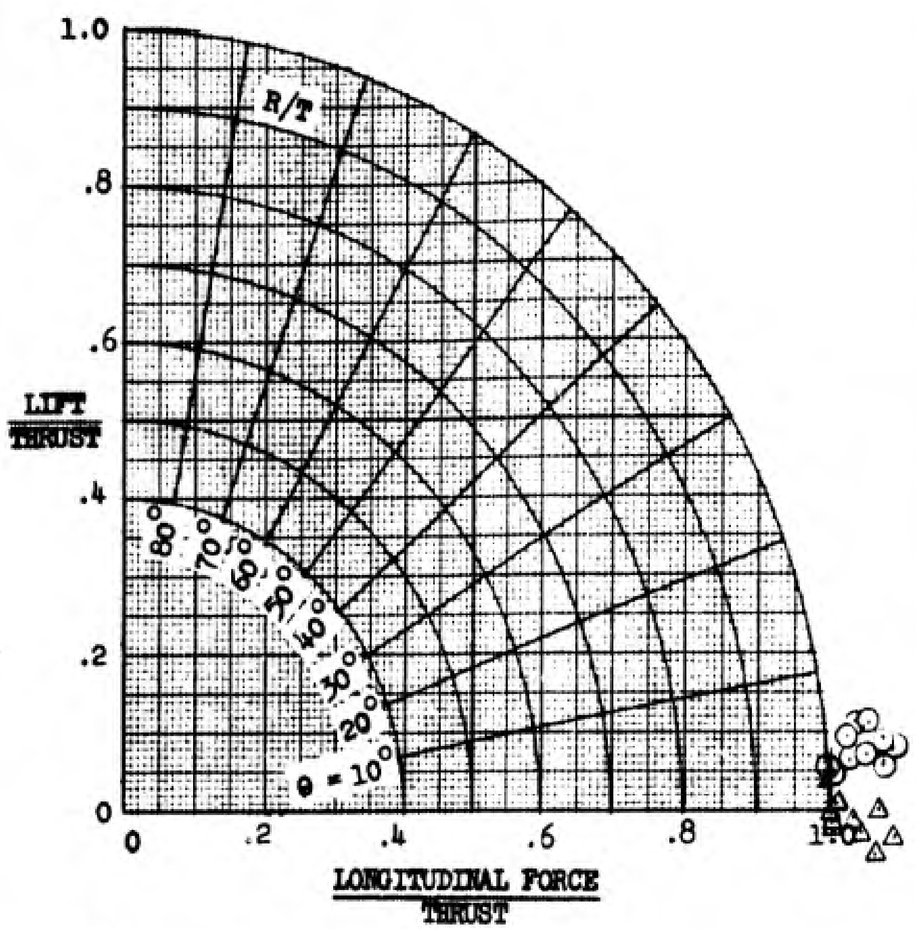
MODEL 88 MONOPLANE CONFIGURATION

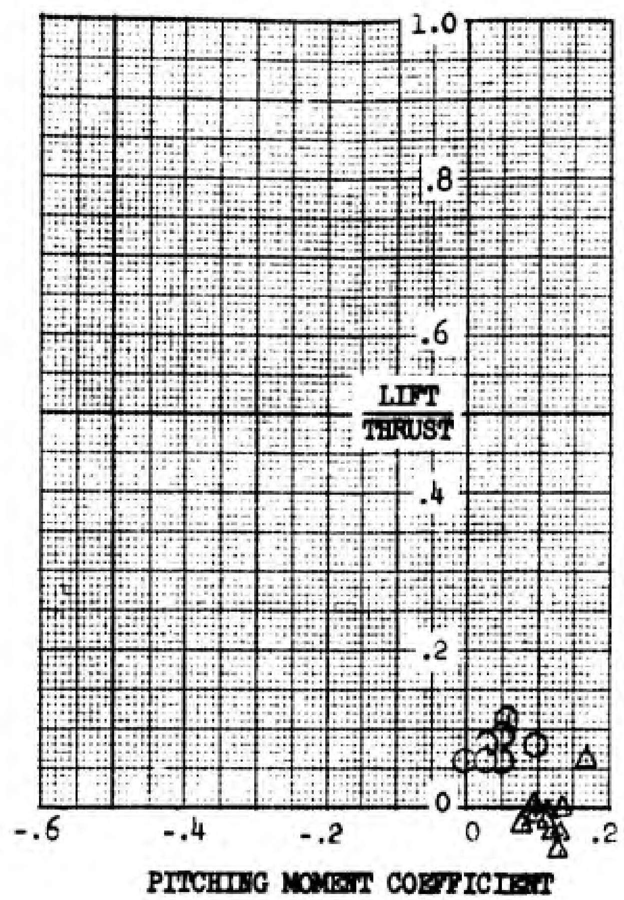
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

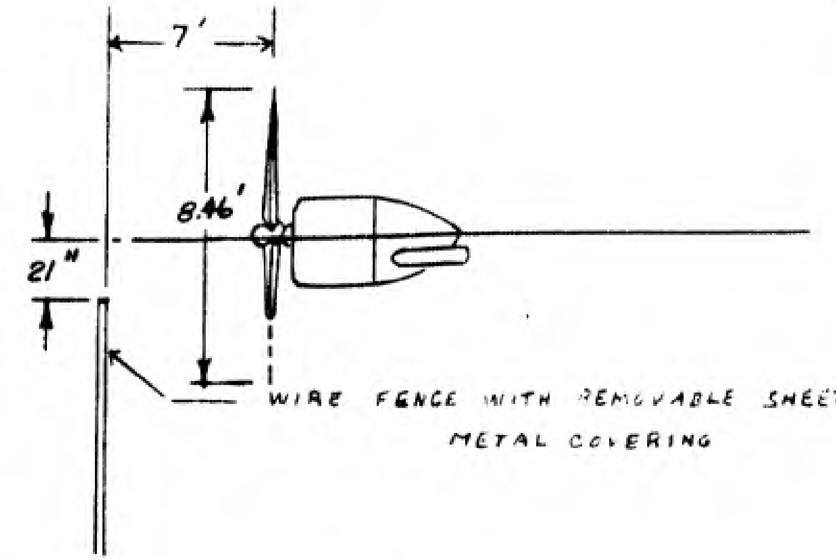
Effect of Fence in Front of Propeller

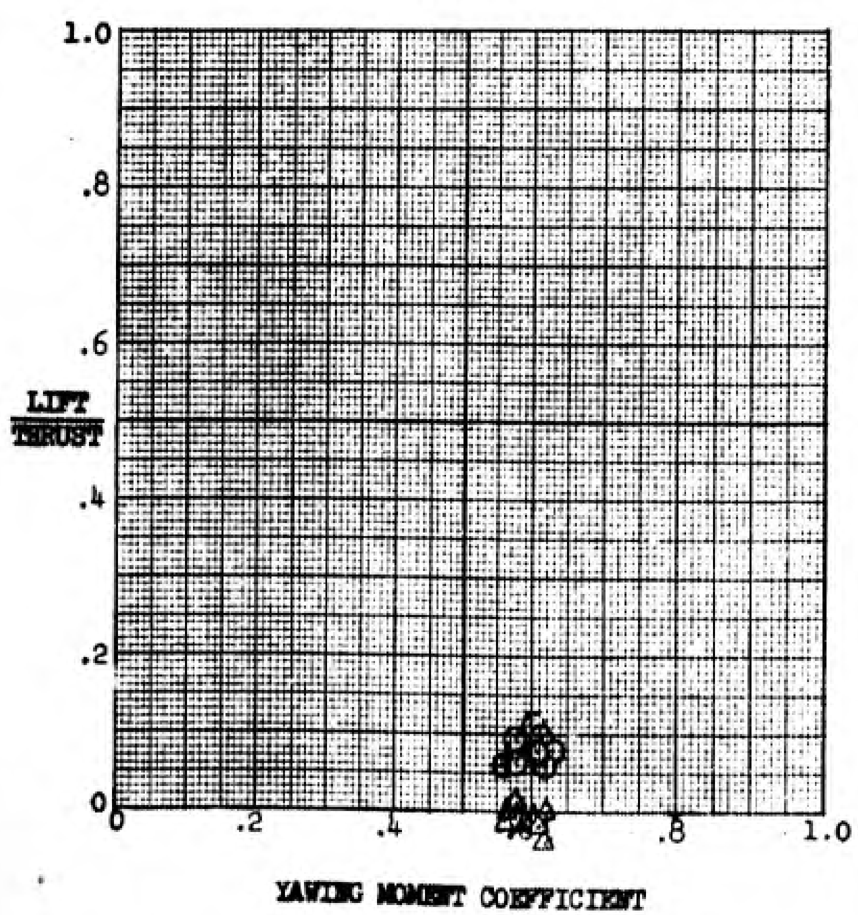
Figure 21

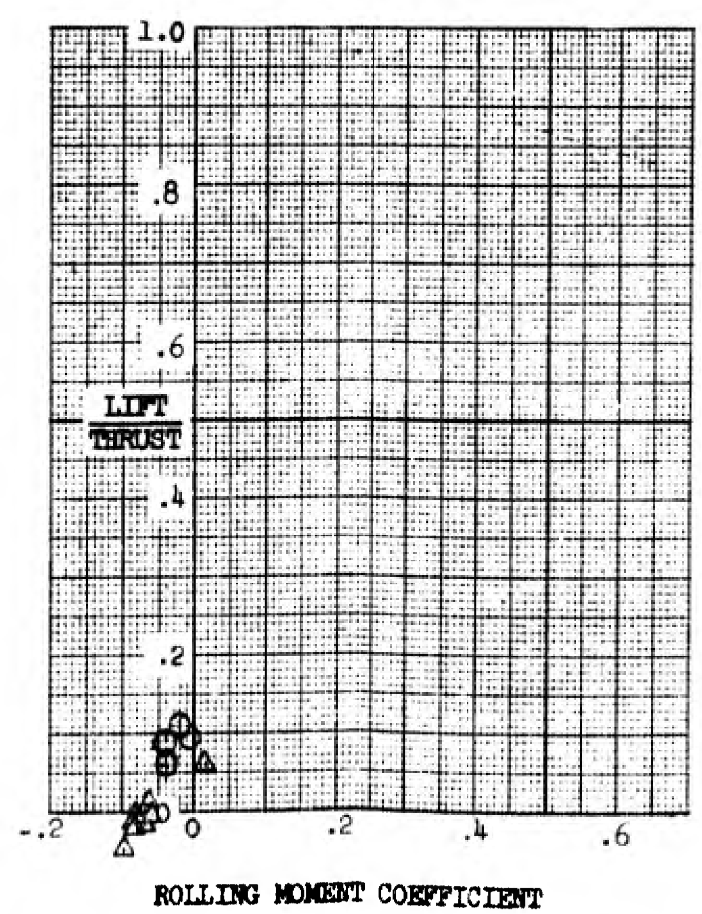
SYM	RUN	FENCE
○	1	UP
△	2	DOWN

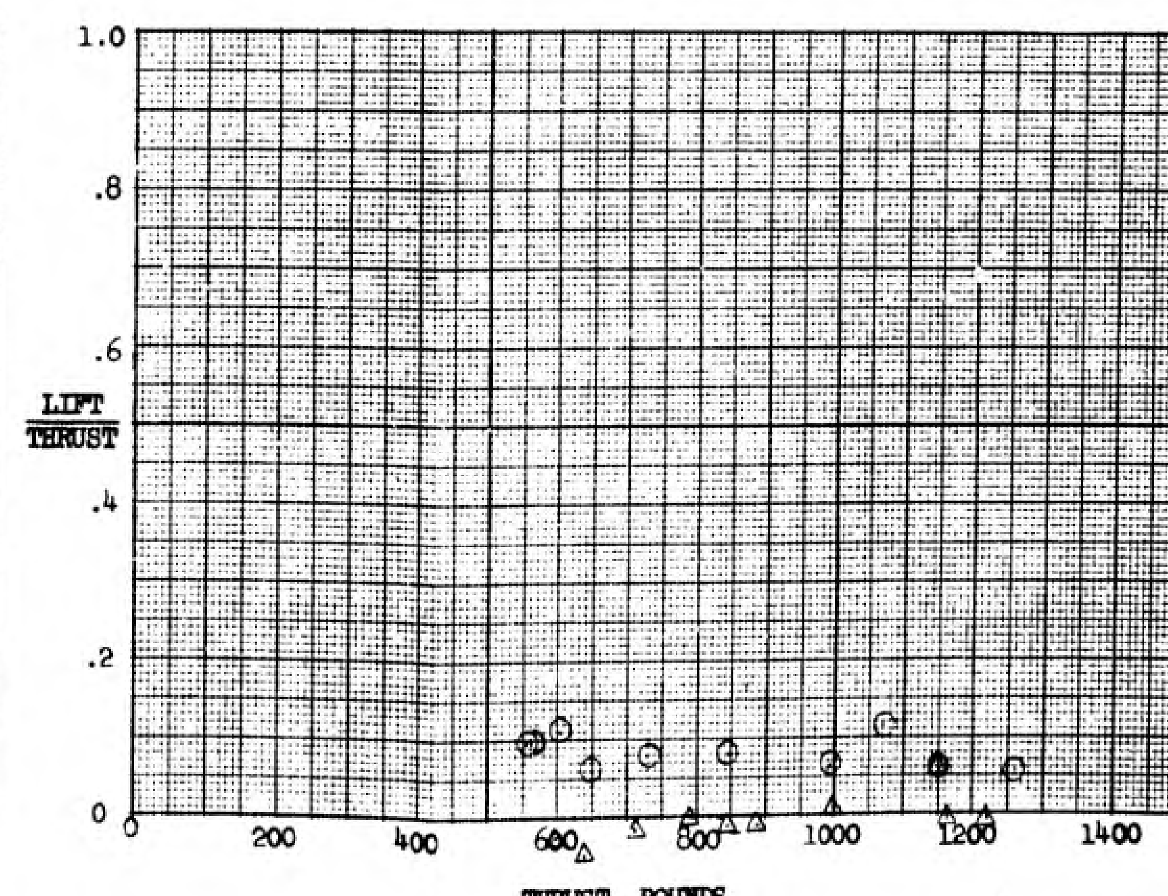










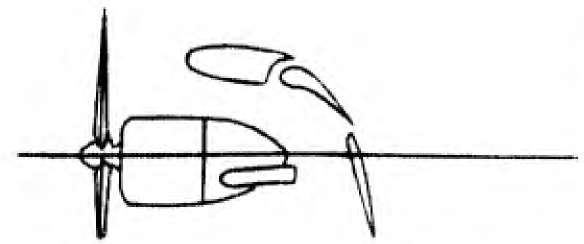


MODEL 88 MONOPLANE CONFIGURATION

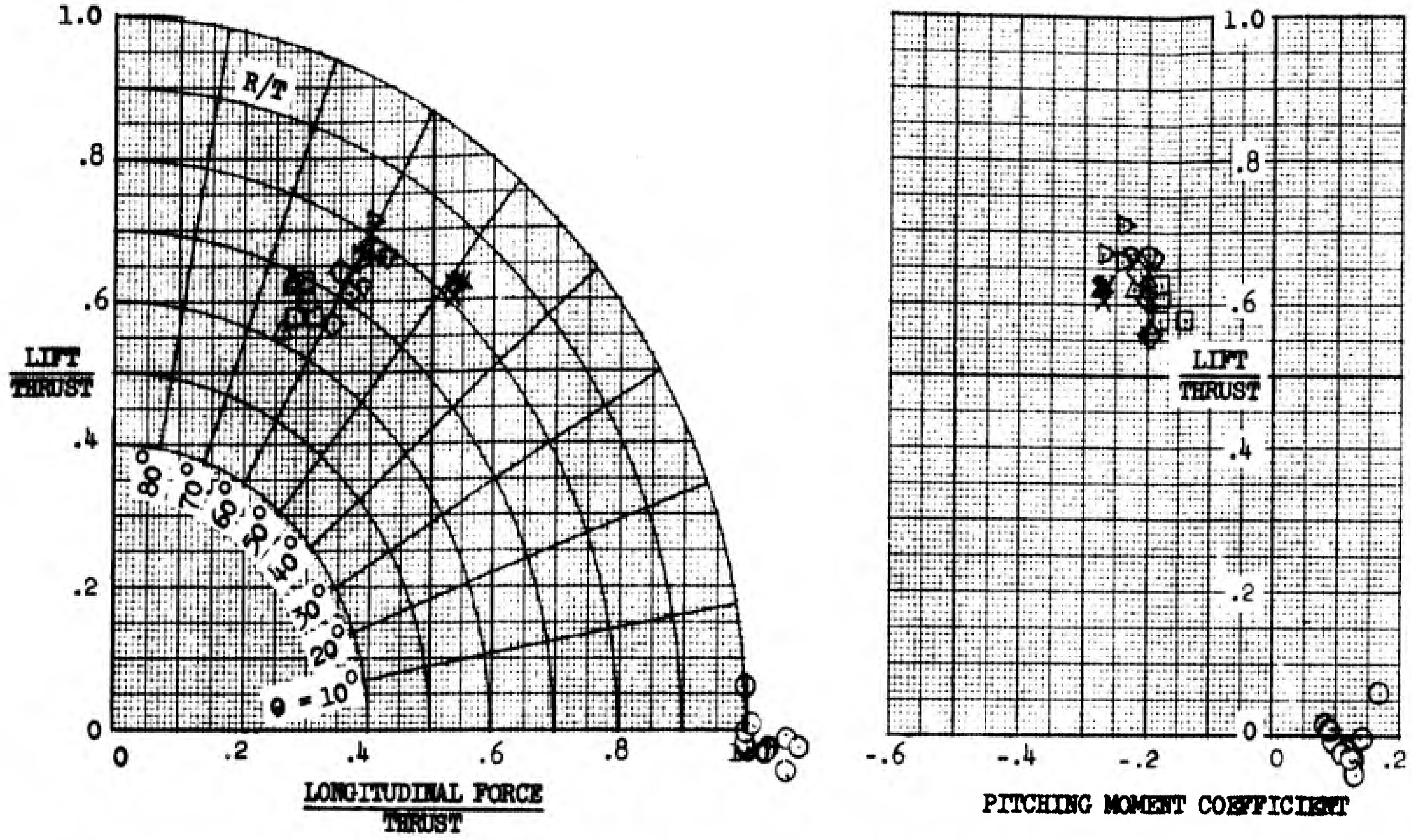
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Flap Deflection, Ground Plane Not Installed

Figure 22



SYM	RUN	FLAP DEFLECTION FORWARD	FLAP DEFLECTION AFT
○	2	0	0
△	8	45	49
□	8.1	45	49
◇	9	45	40
▷	10	45	30
▽	10.1	45	30
X	41	30	30



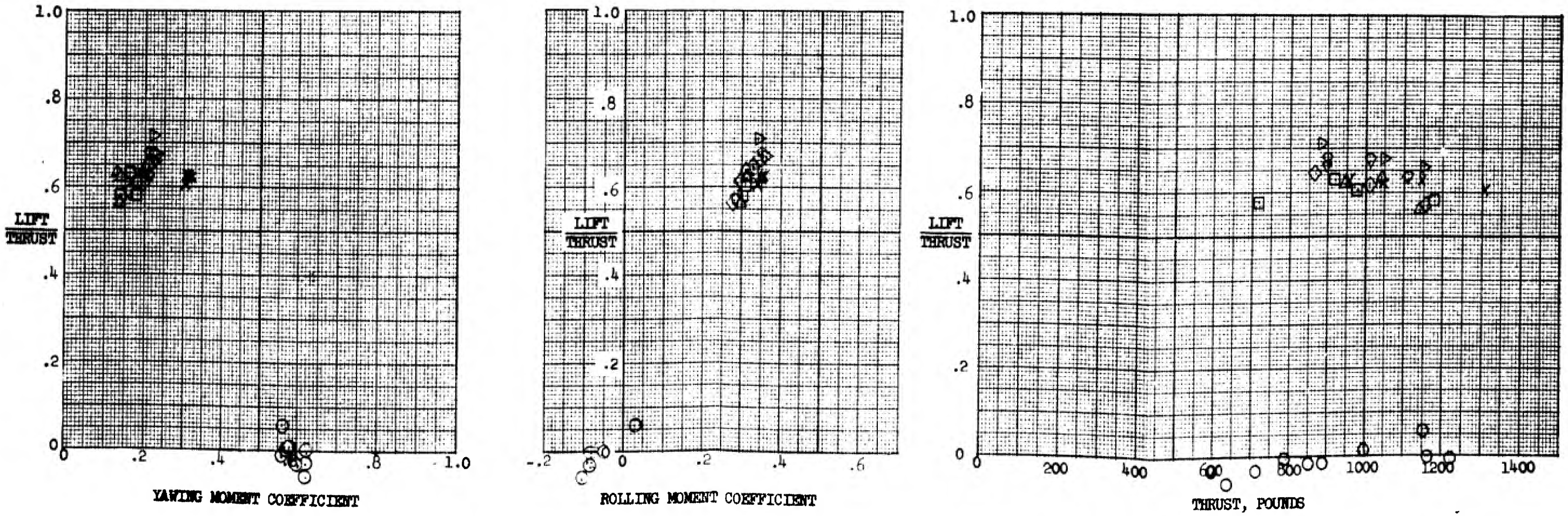


Figure 23

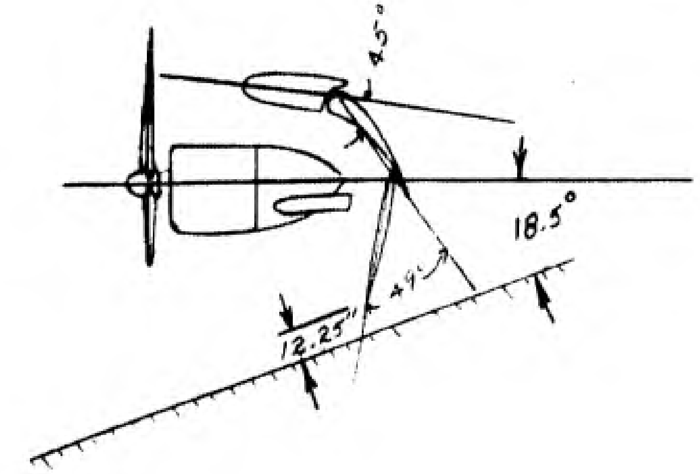
MODEL 88 MONOPLANE CONFIGURATION

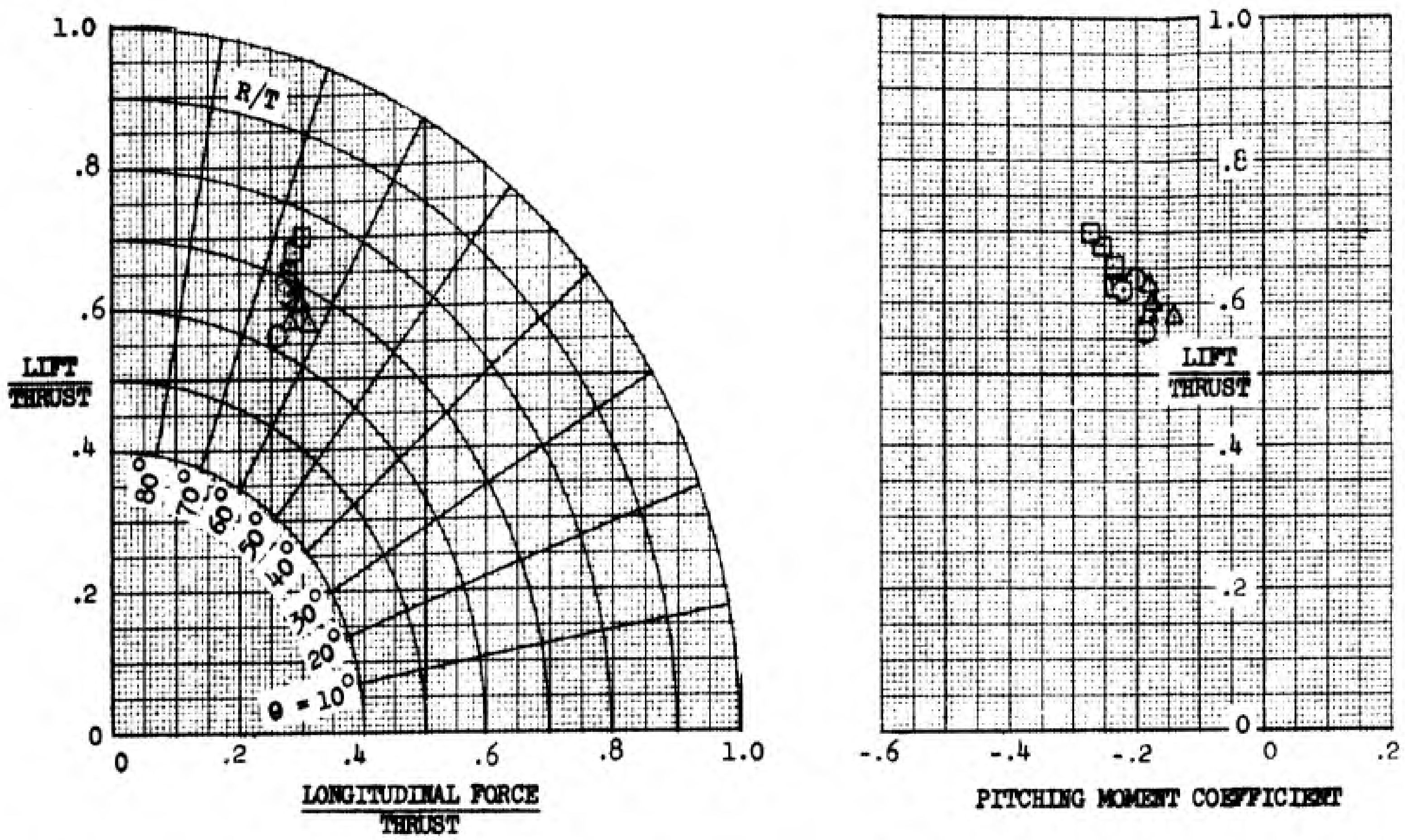
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Ground Plane With 45° Forward Flap Deflection

And 49° Aft Flap Deflection

SYM.	RUN	PLANE
○	8	OUT
△	8.1	OUT
□	13	IN





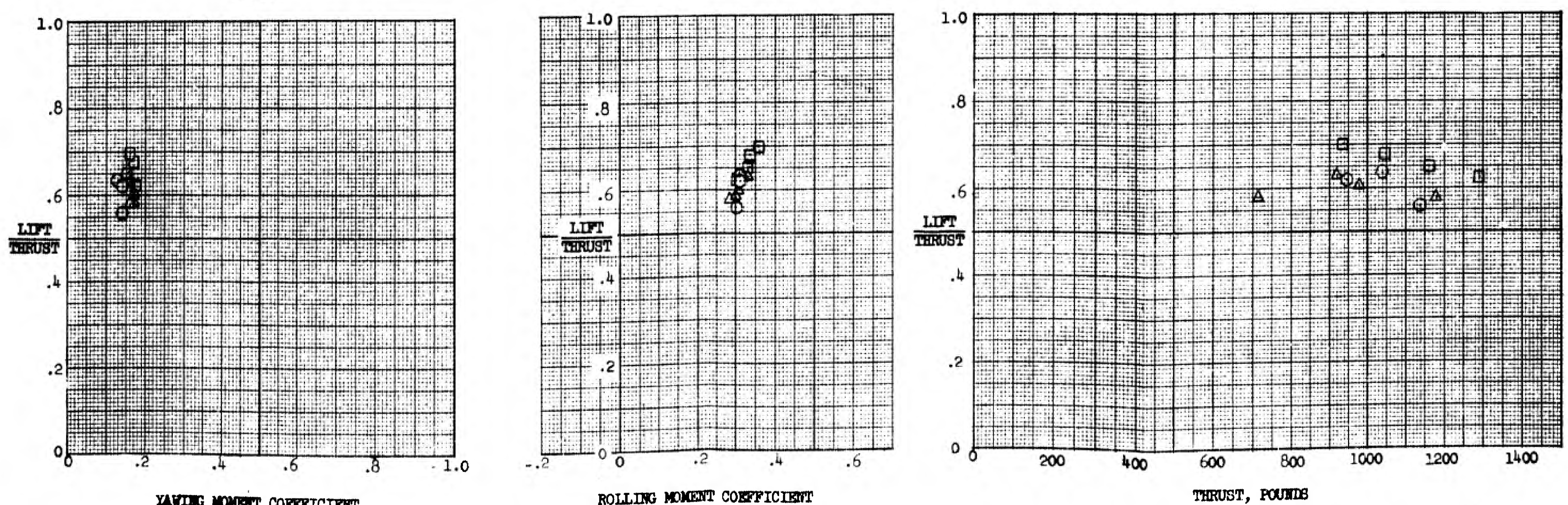


Figure 24

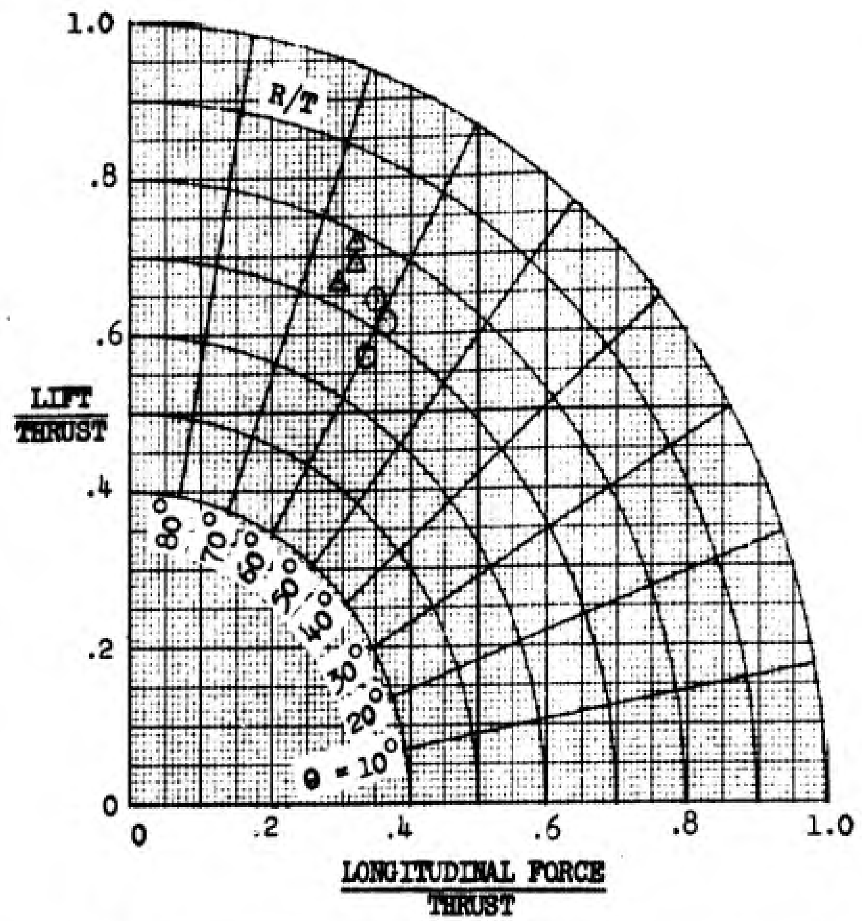
MODEL 88 MONOPLANE CONFIGURATION

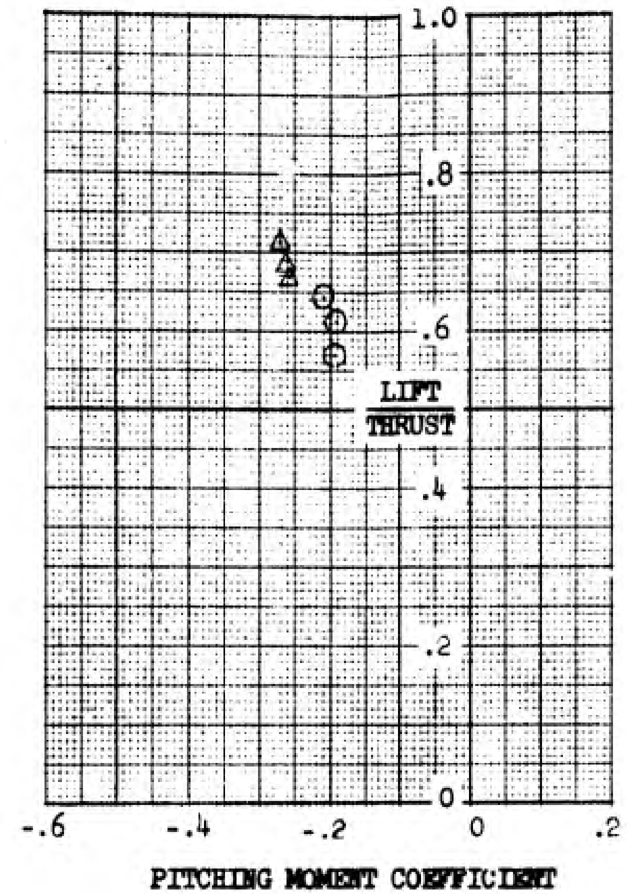
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

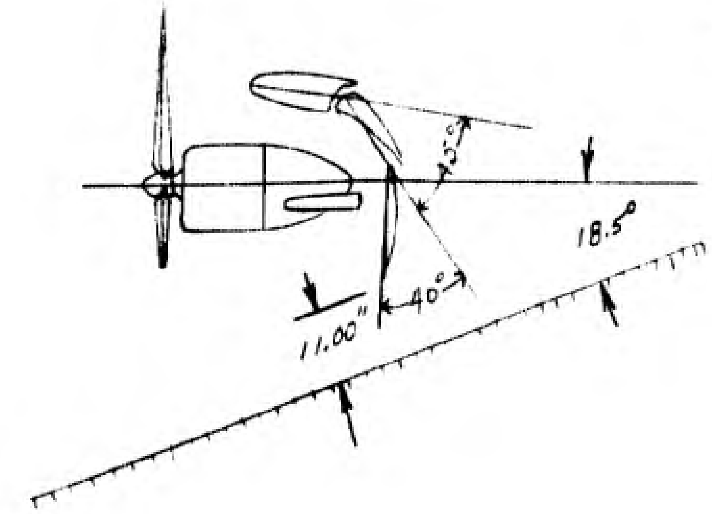
Effect of Ground Plane With 45° Forward Flap Deflection

And 40° Aft Flap Deflection

SYM	RUN	PLANE
○	9	OUT
△	12	IN







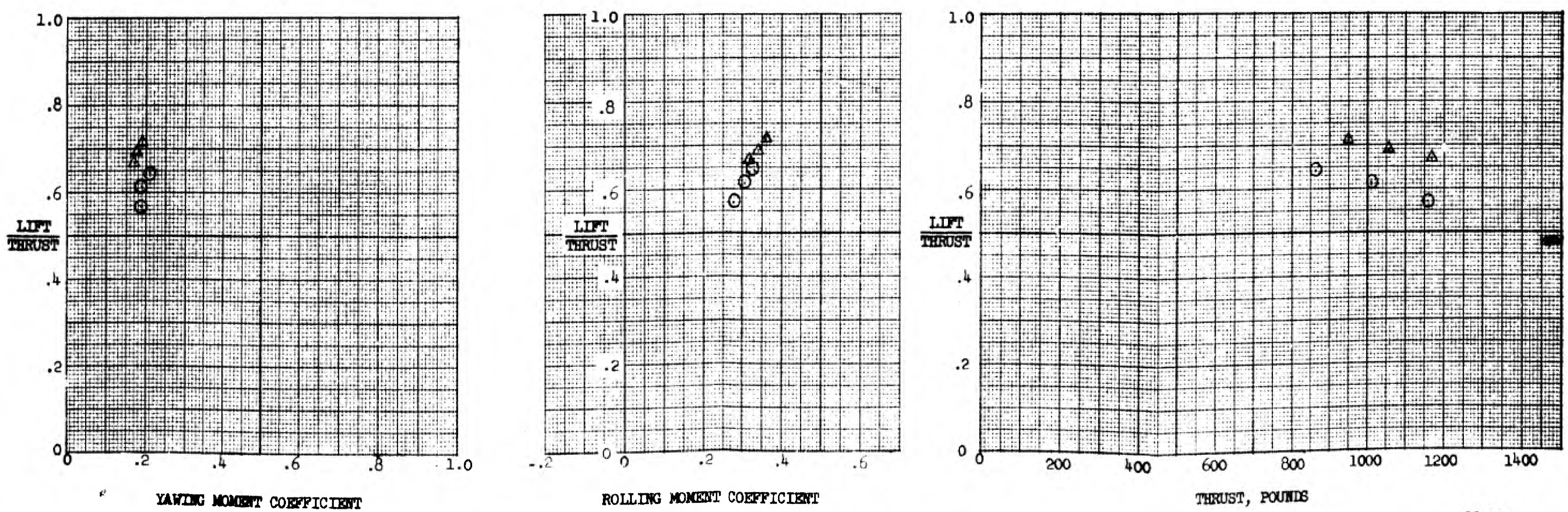


Figure 25

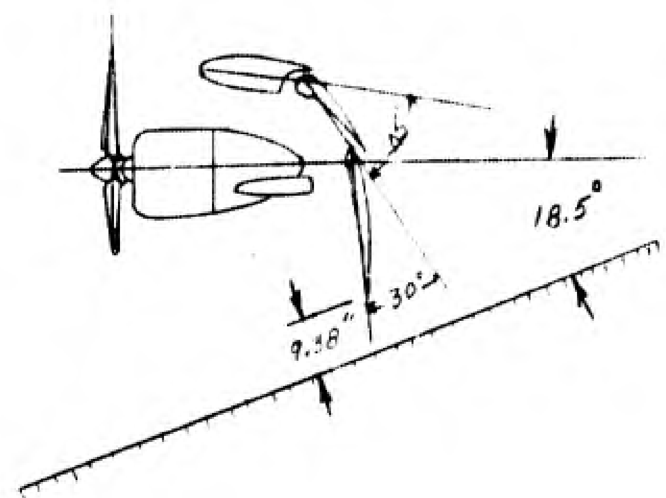
MODEL 88 MONOPLANE CONFIGURATION

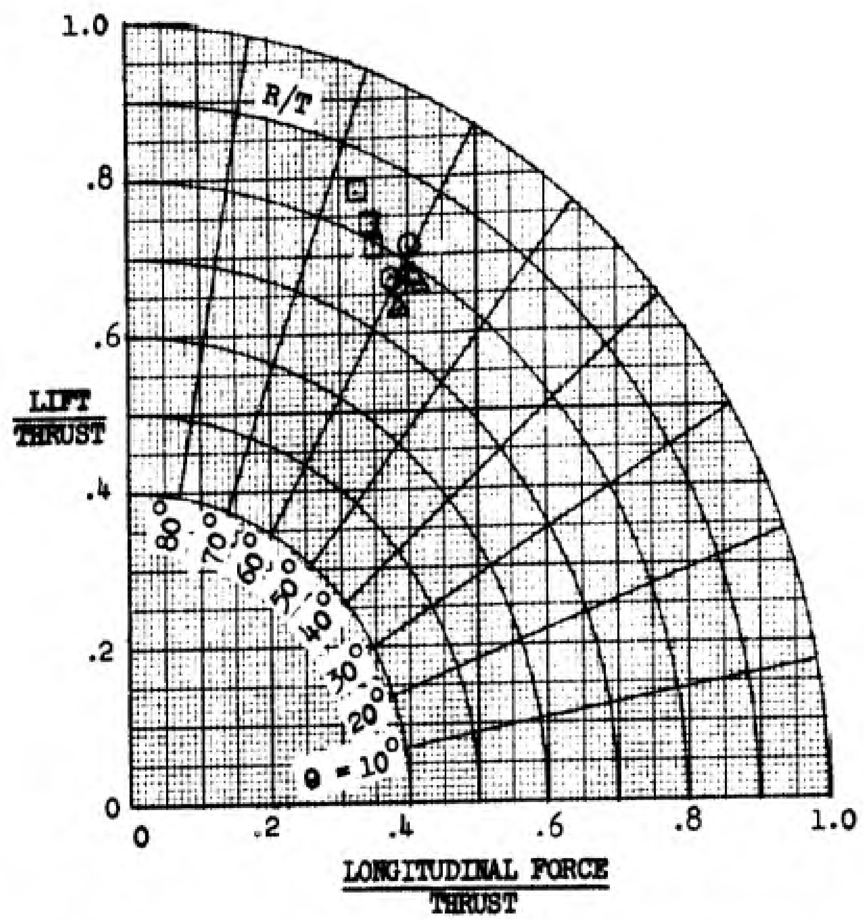
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

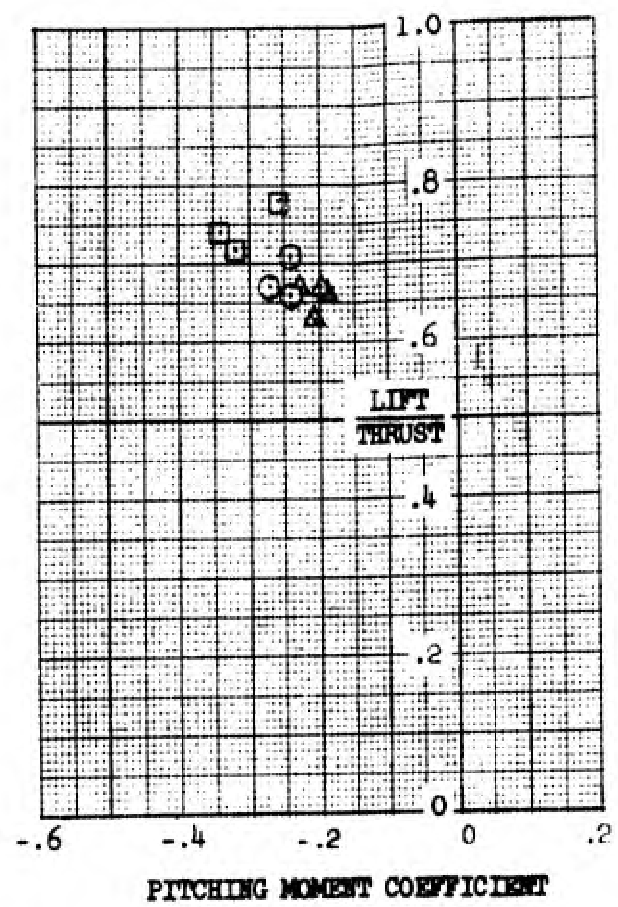
Effect of Ground Plane With 45° Forward Flap Deflection

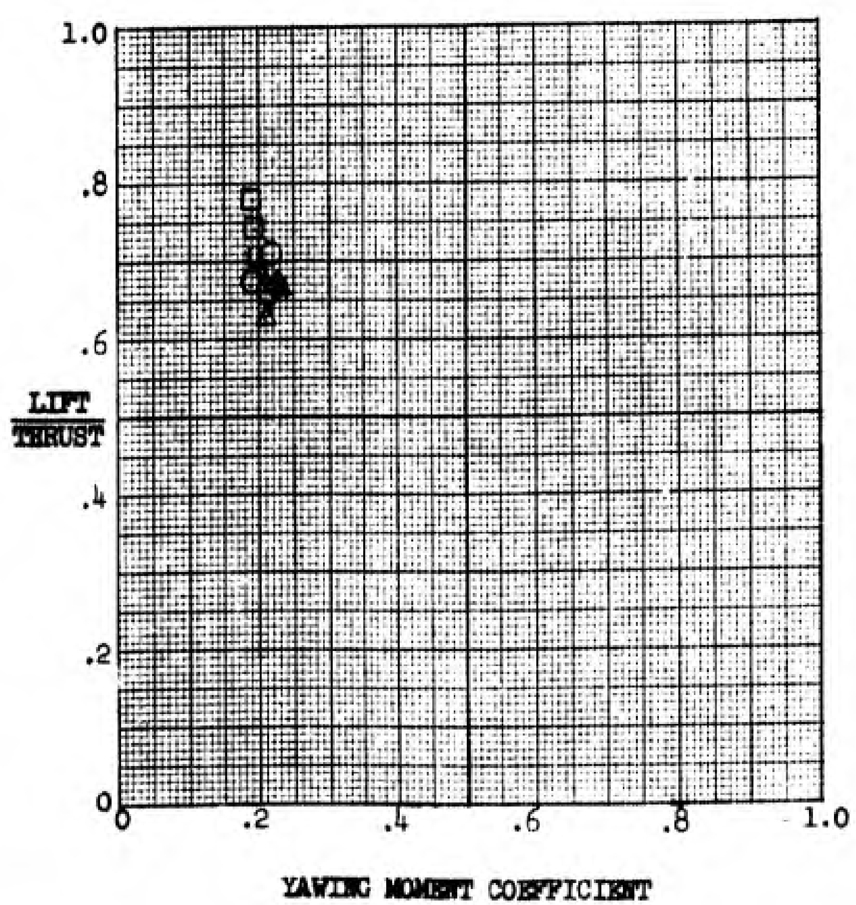
And 30° Aft Flap Deflection

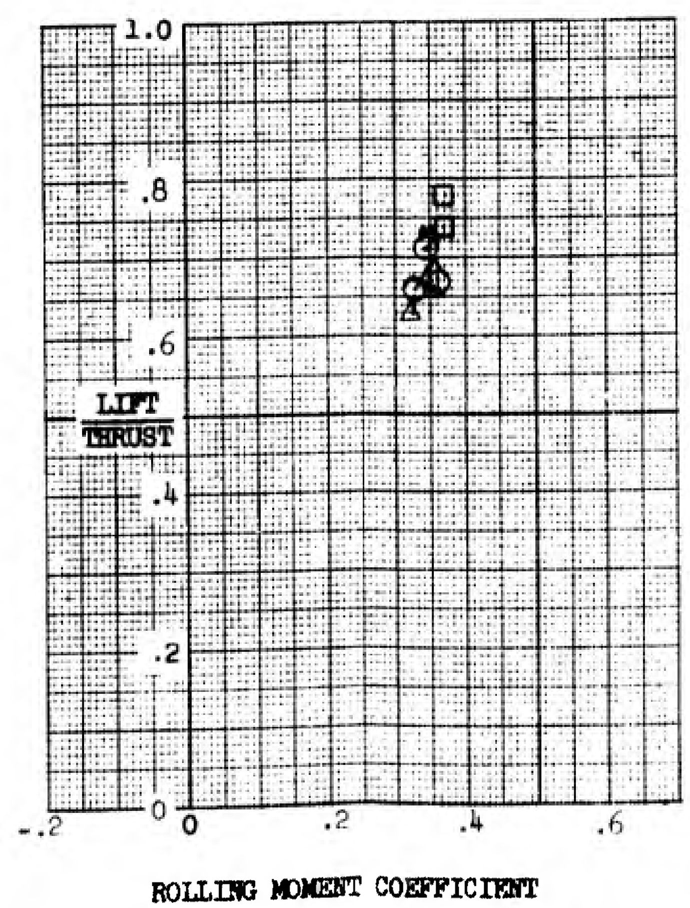
SYM	RUN	PLANE
○	10	OUT
△	10.1	OUT
□	11	IN

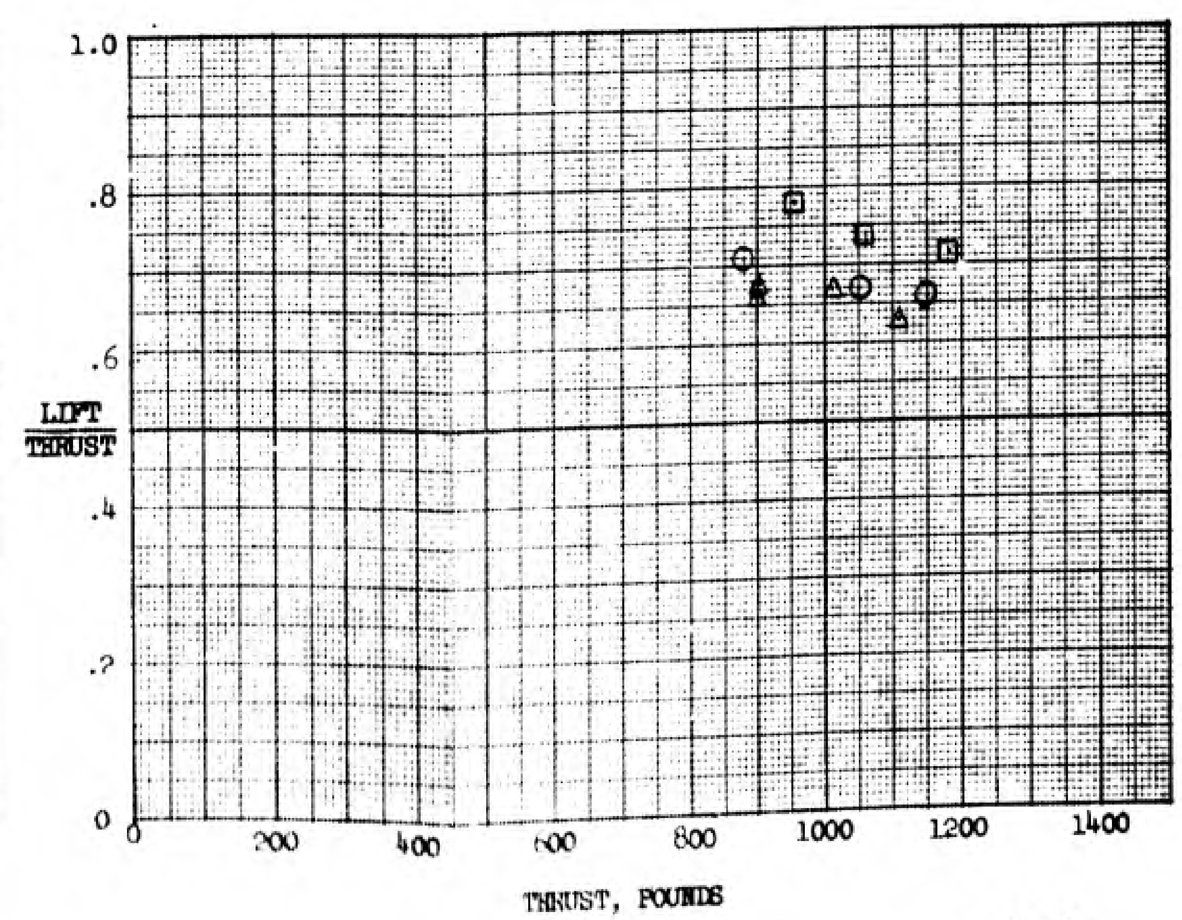












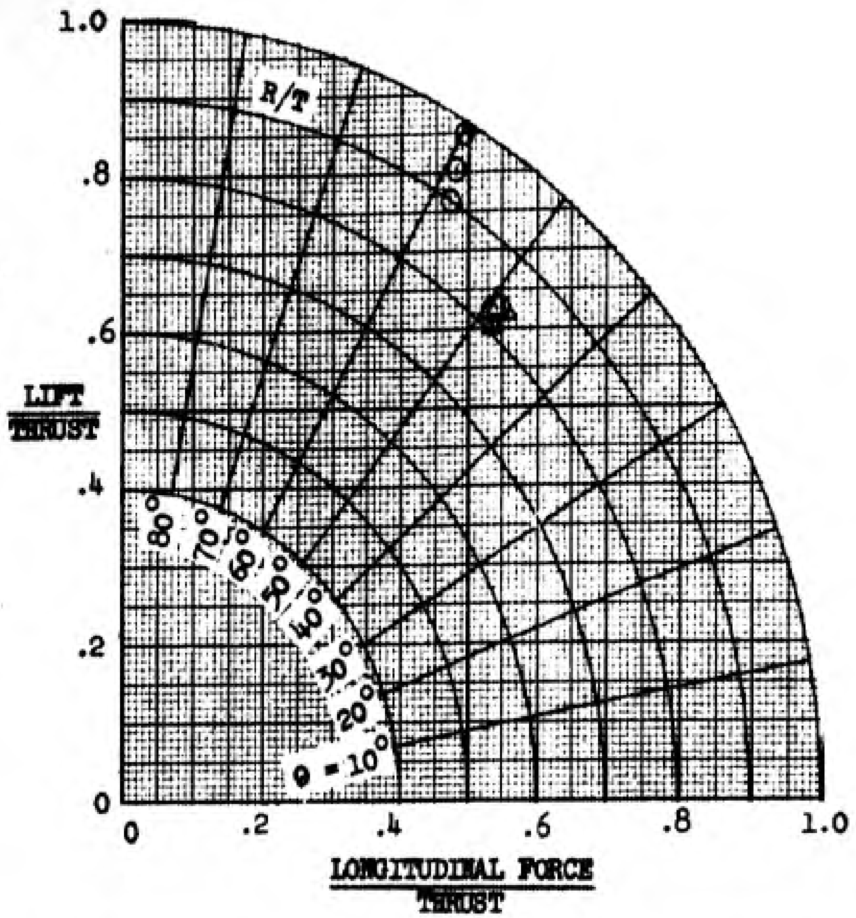
MODEL 88 MONOPLANE CONFIGURATION

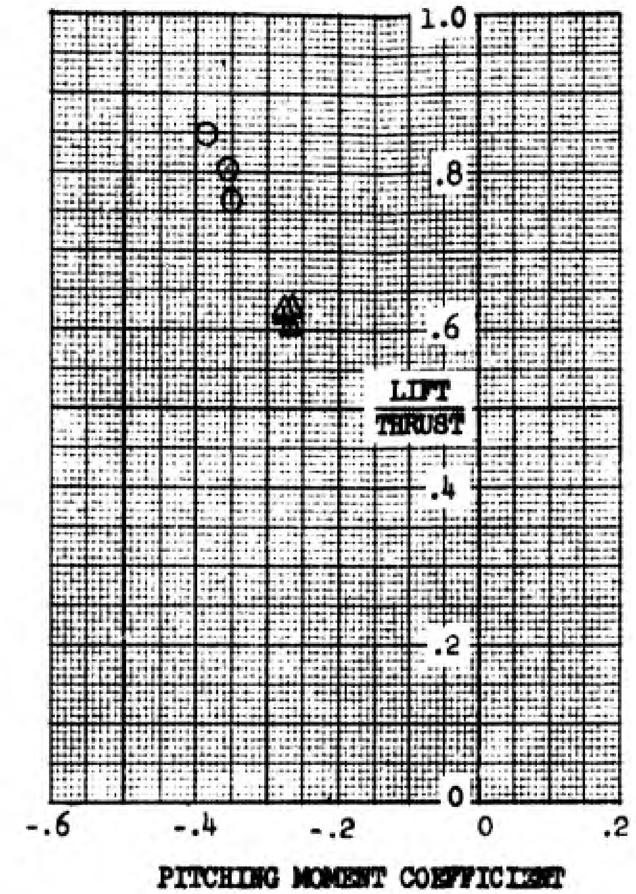
Figure 26

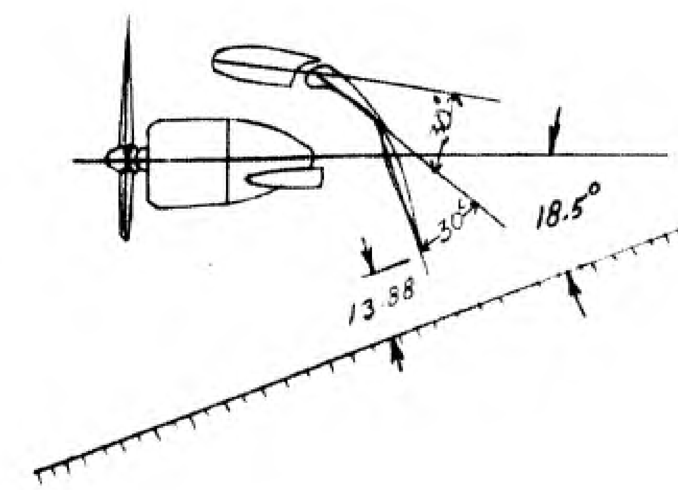
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

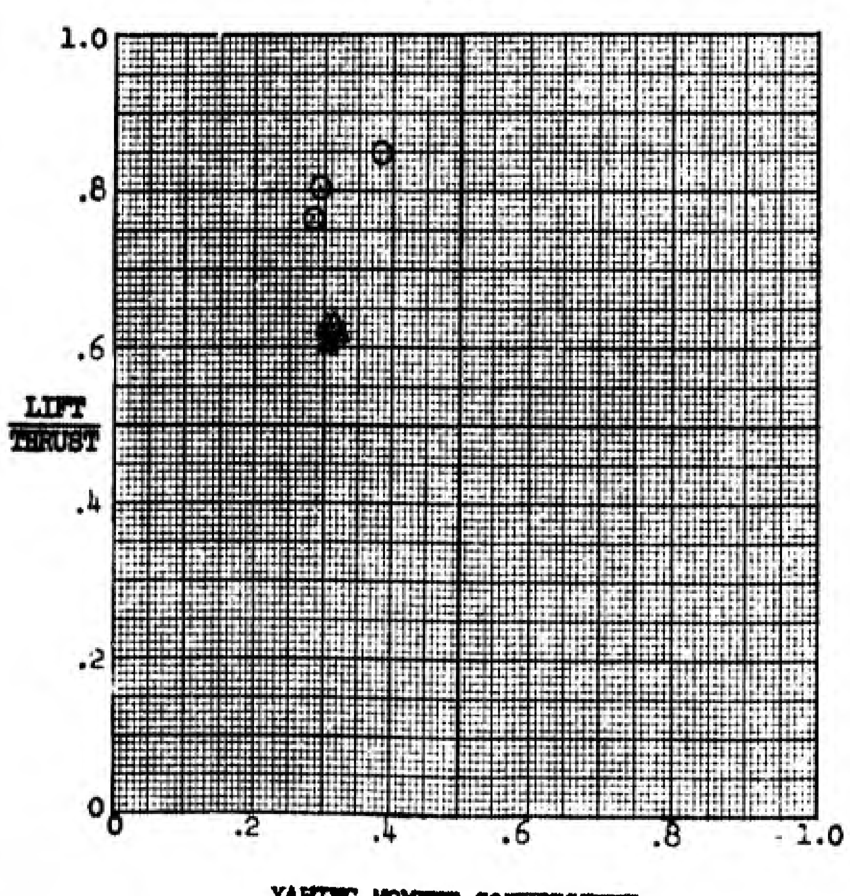
Effect of Ground Plane With 30° Forward and Aft Flap Deflection

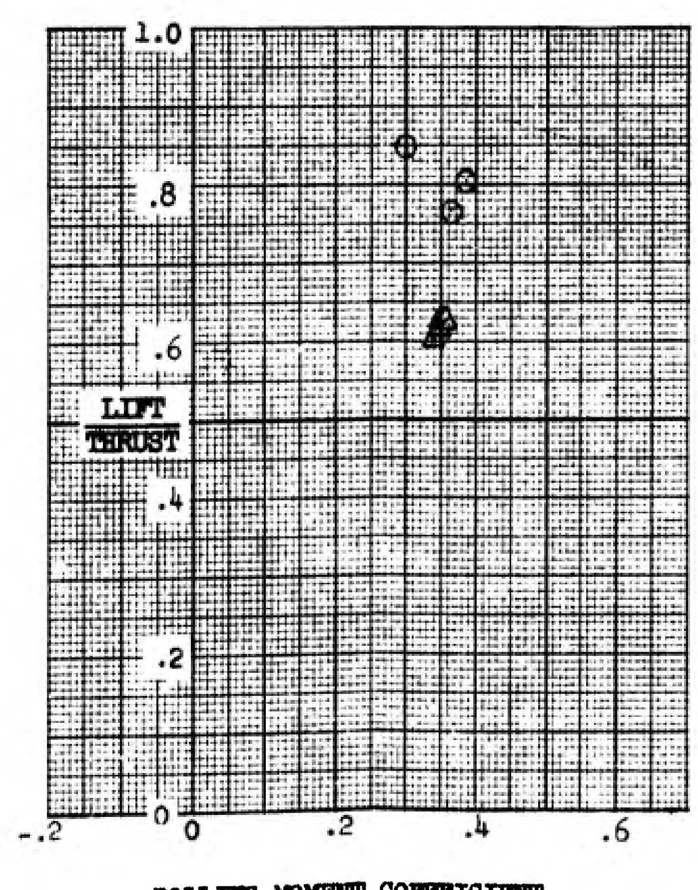
SYM	RUN	PLANE
○	16	IN
△	41	OUT

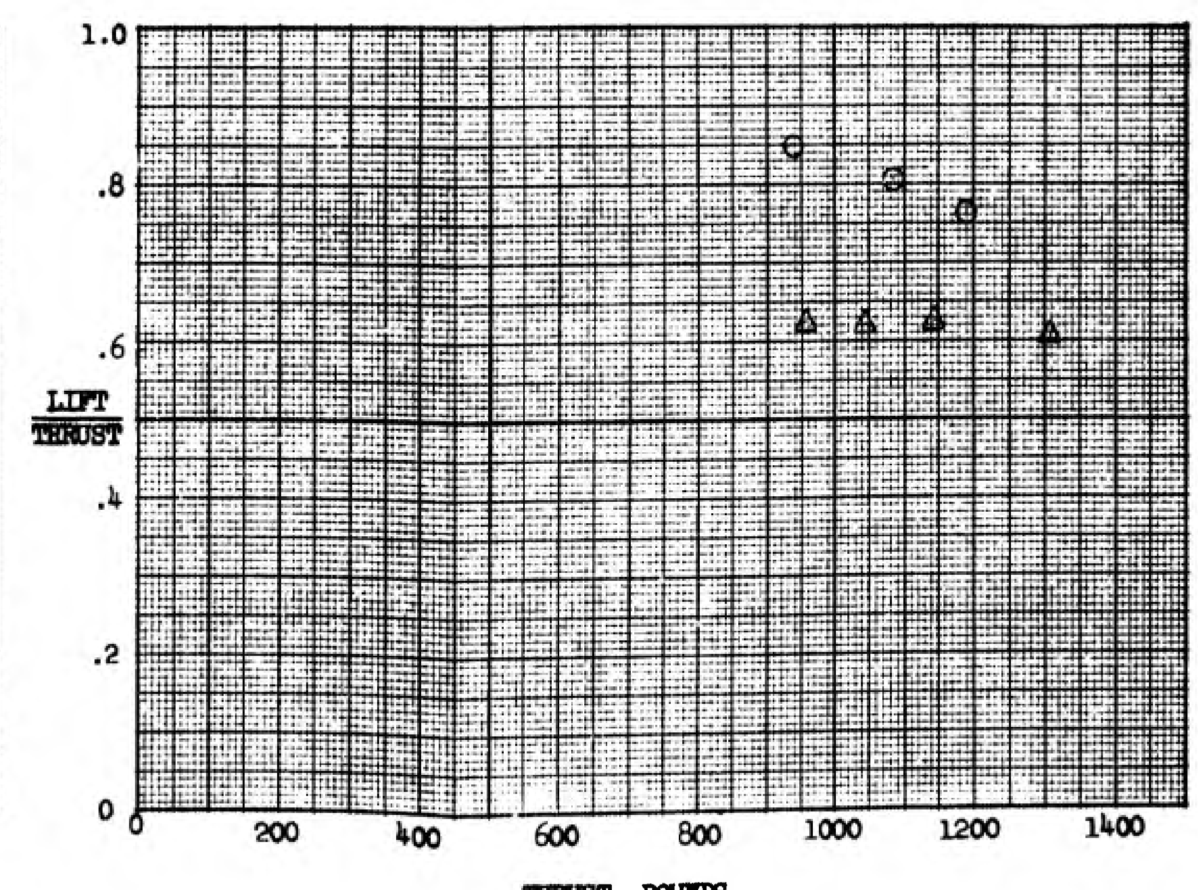












MODEL 88 MONOPLANE CONFIGURATION

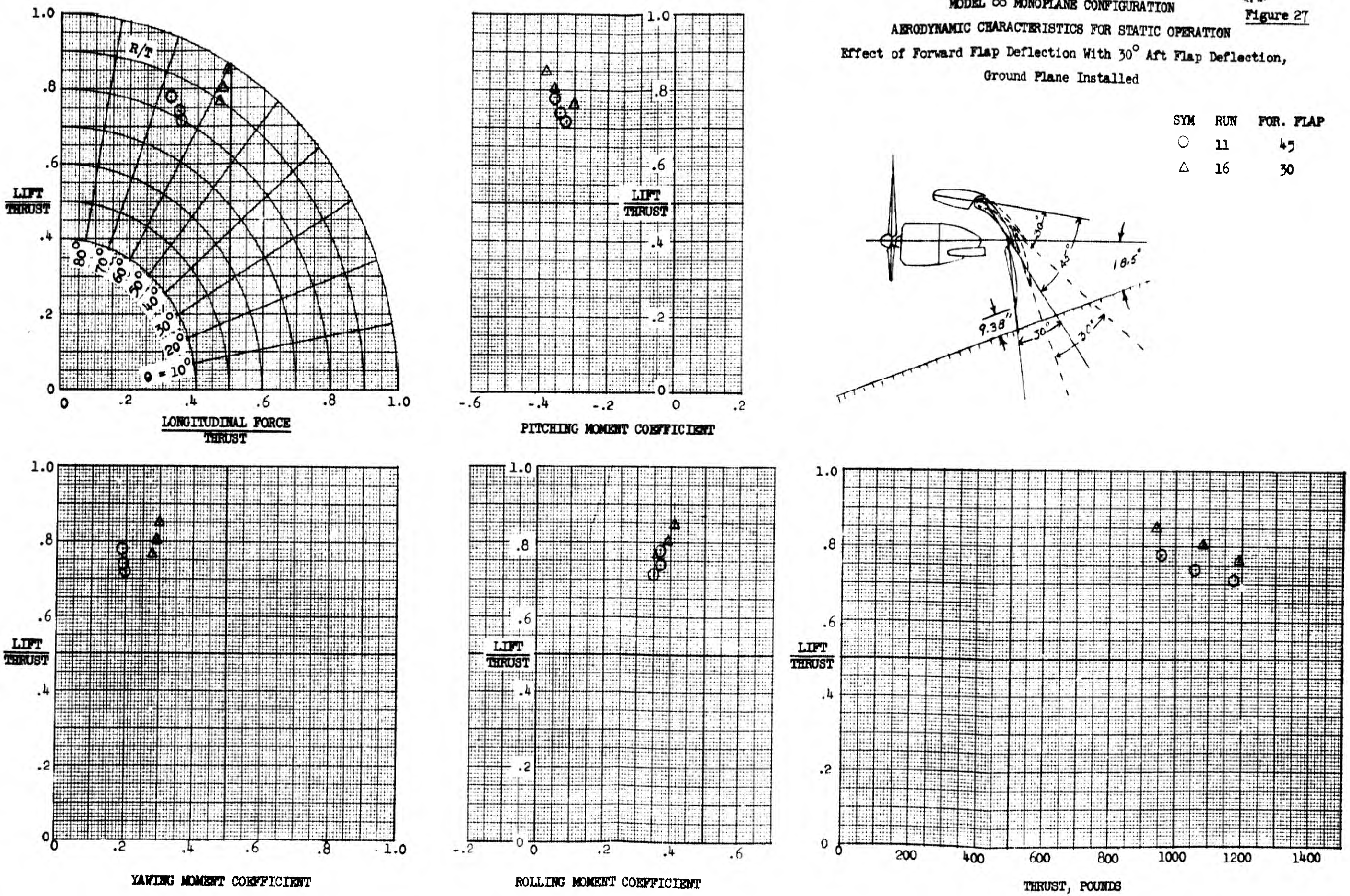
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Forward Flap Deflection With 30° Aft Flap Deflection,

Ground Plane Installed

Figure 27

SYM	RUN	FOR. FLAP
○	11	45
△	16	30



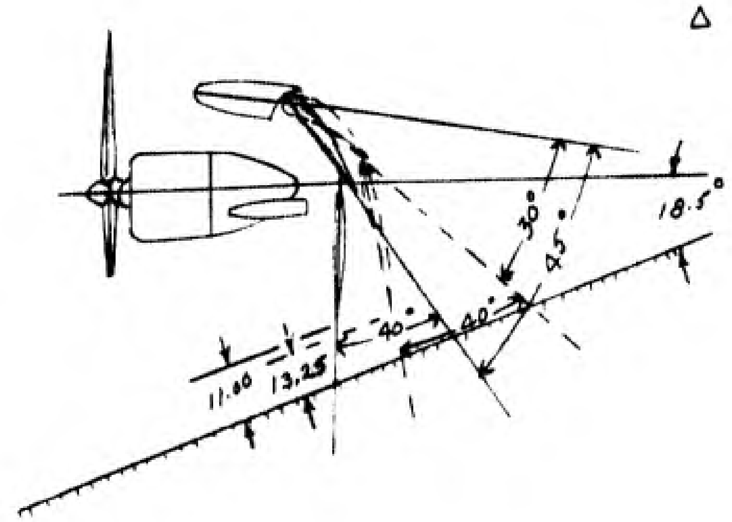
MODEL 88 MONOPLANE CONFIGURATION

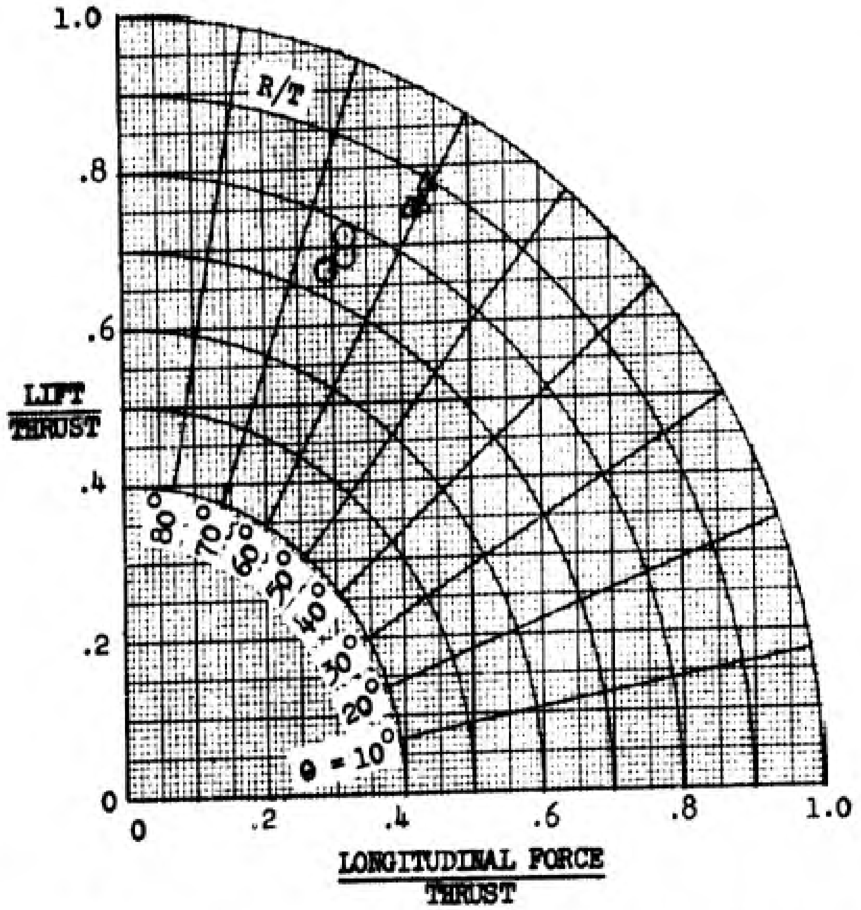
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

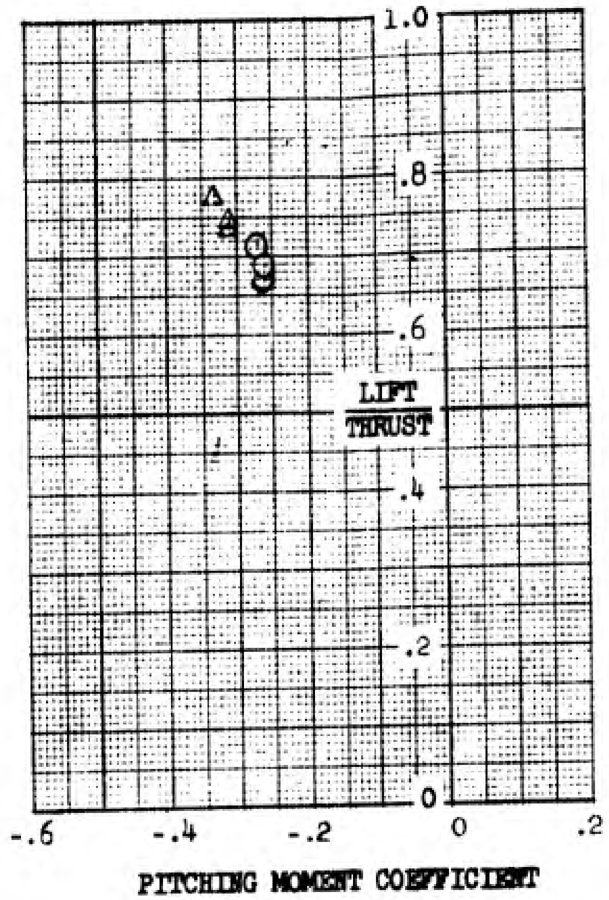
Effect of Forward Flap Deflection With 40° Aft Flap Deflection, Ground Plane Installed

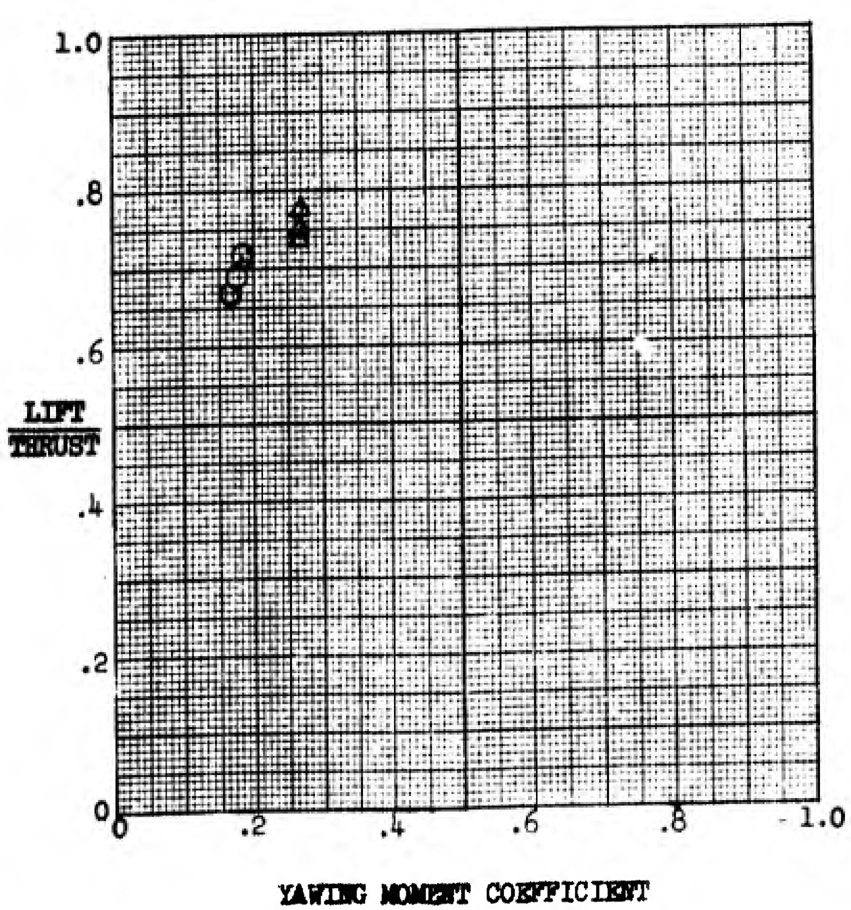
Figure 28

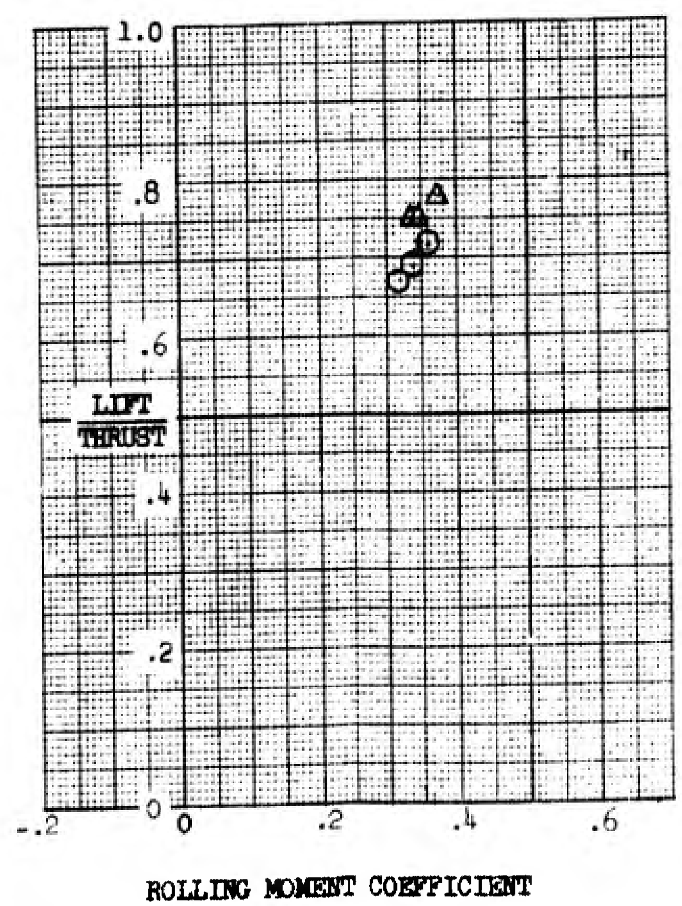
SYM	RUN	FOR. FLAP
○	12	45
△	17	30

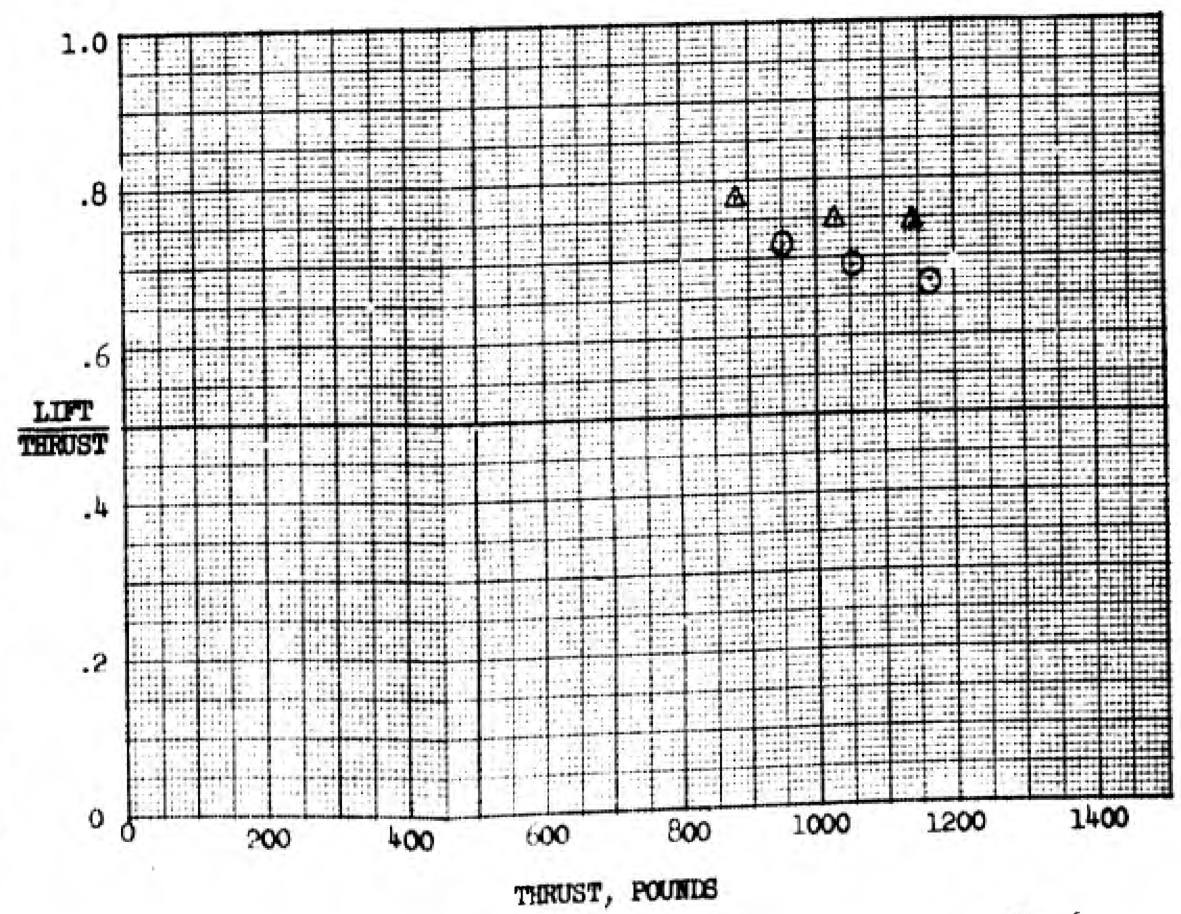












MODEL 88 MONOPLANE CONFIGURATION

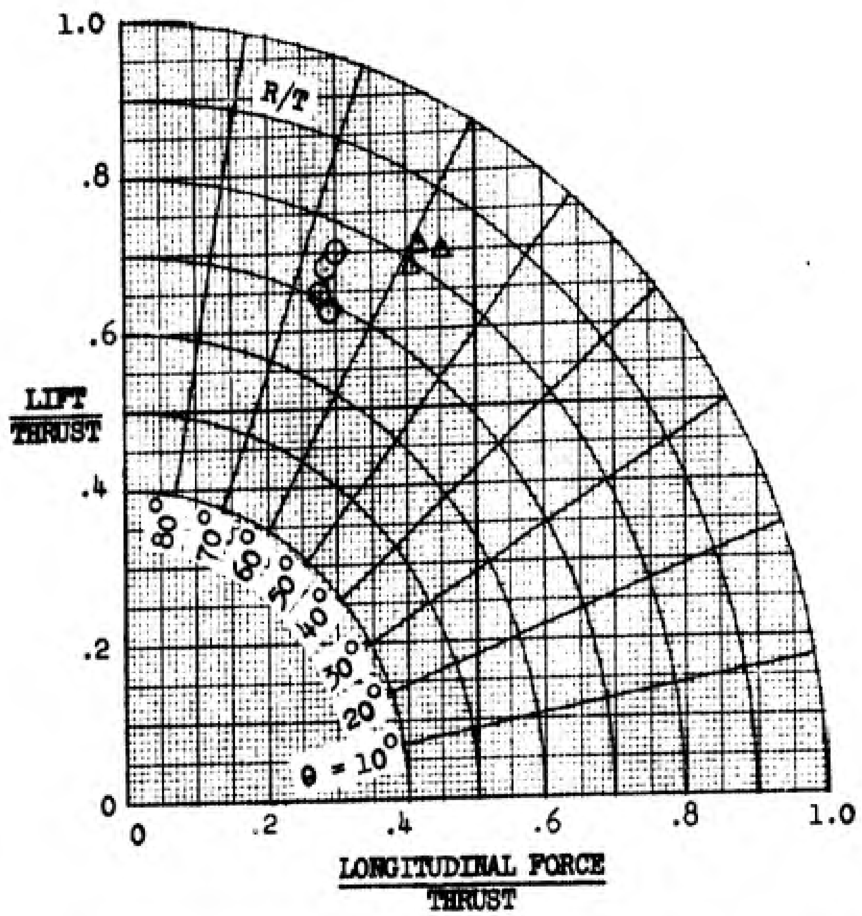
Figure 29

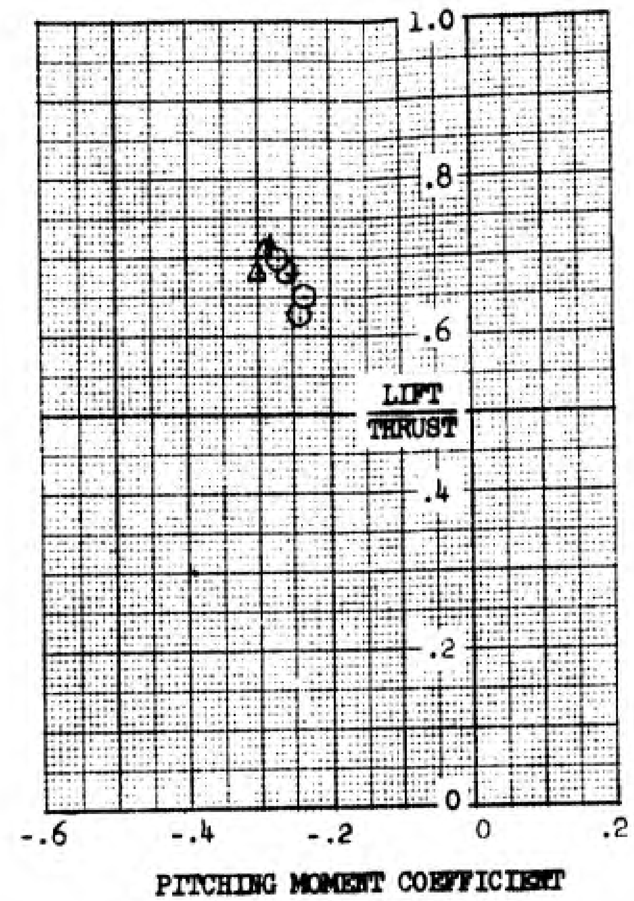
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

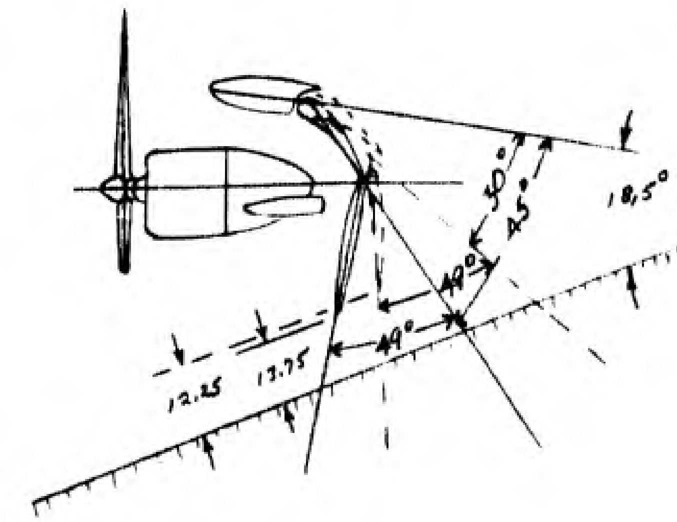
Effect of Forward Flap Deflection With 49° Aft Flap Deflection,

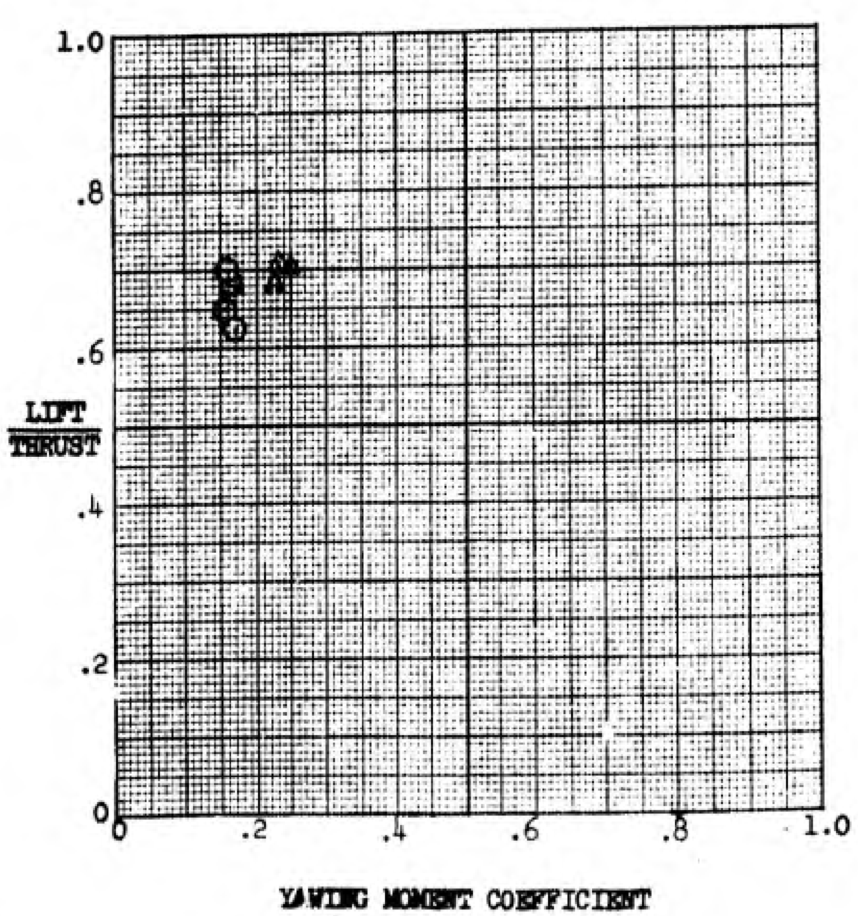
Ground Plane Installed

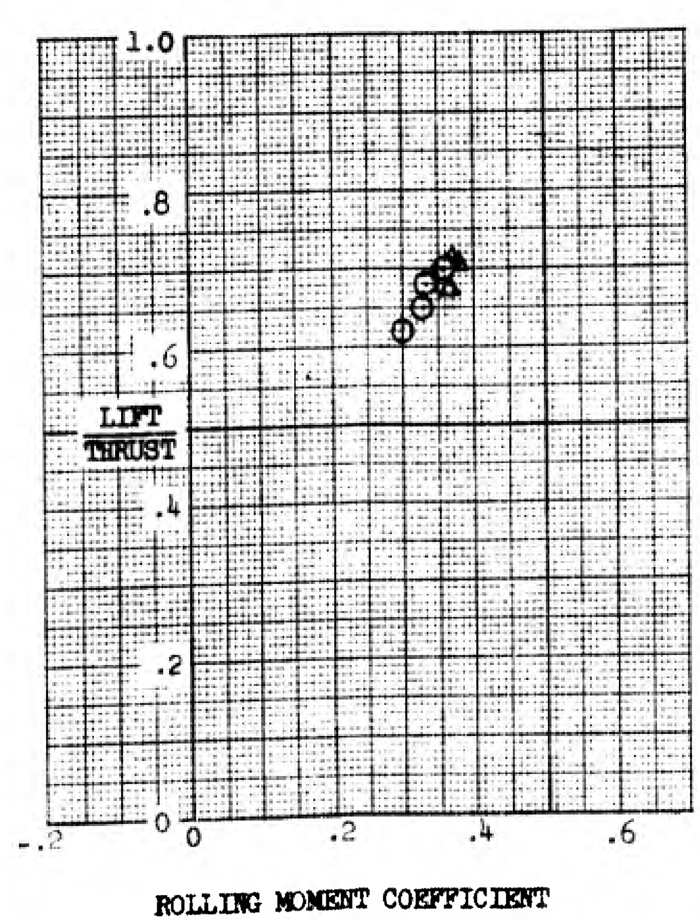
SYM	RUN	FOR. FLAP
○	13	45
Δ	18	30

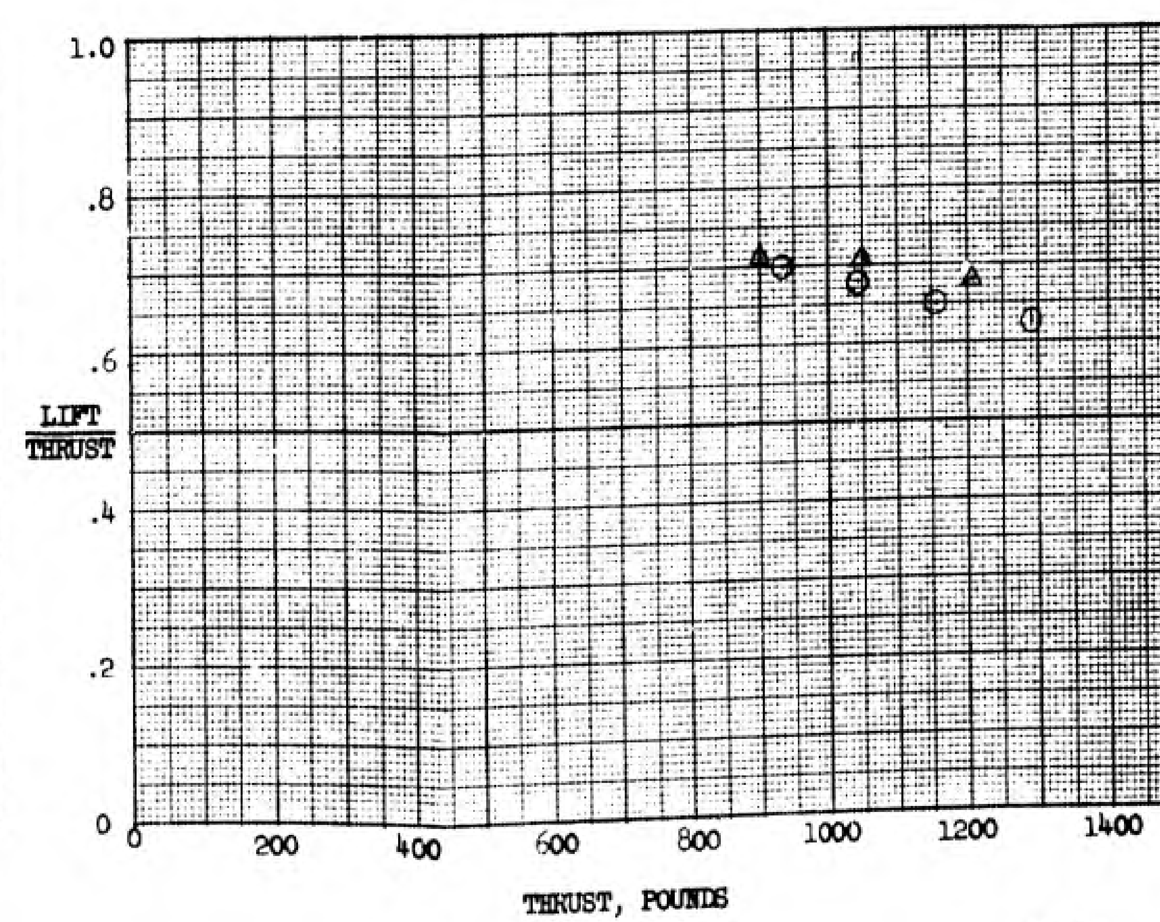












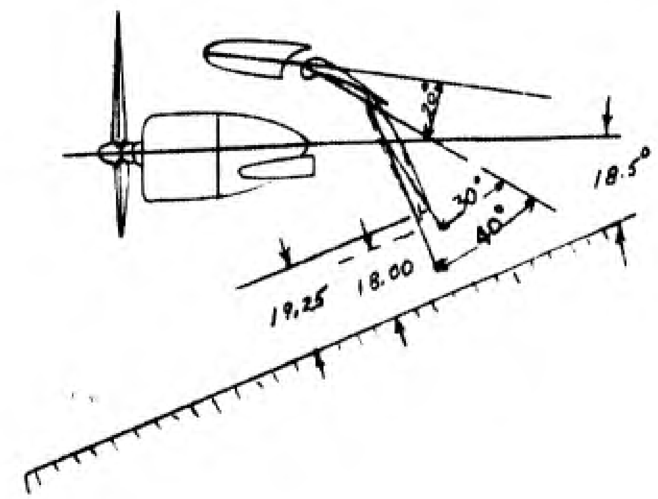
MODEL 88 MONOPLANE CONFIGURATION

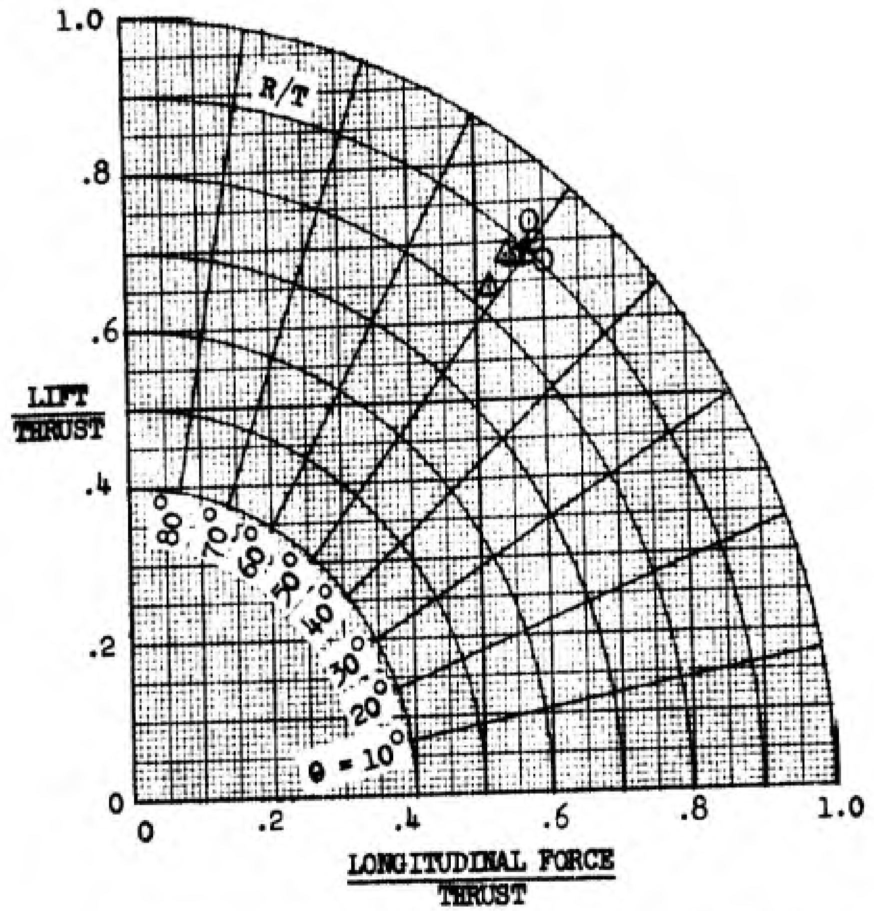
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

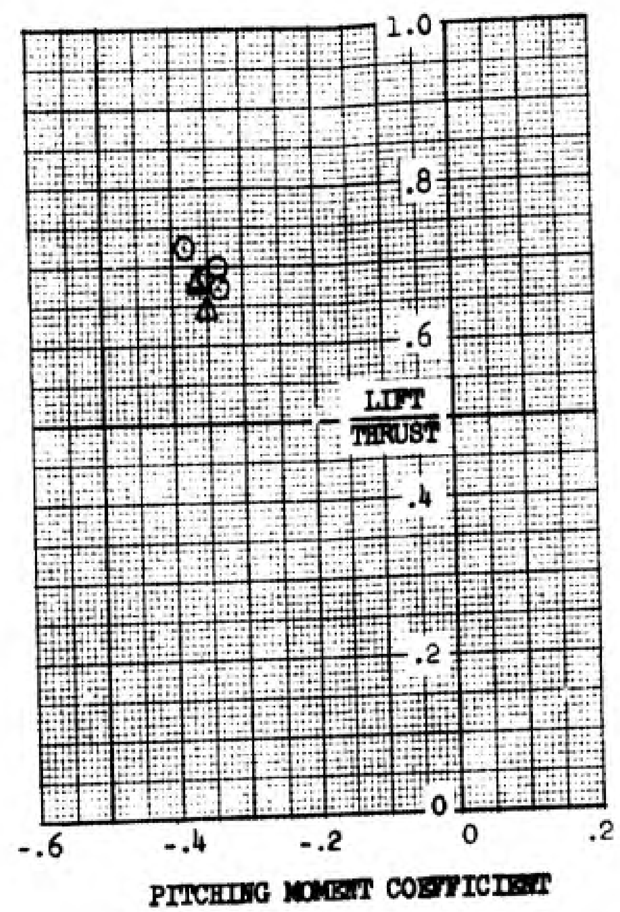
Effect of Aft Flap Deflection With 20° Forward Flap Deflection,
Ground Plane Installed

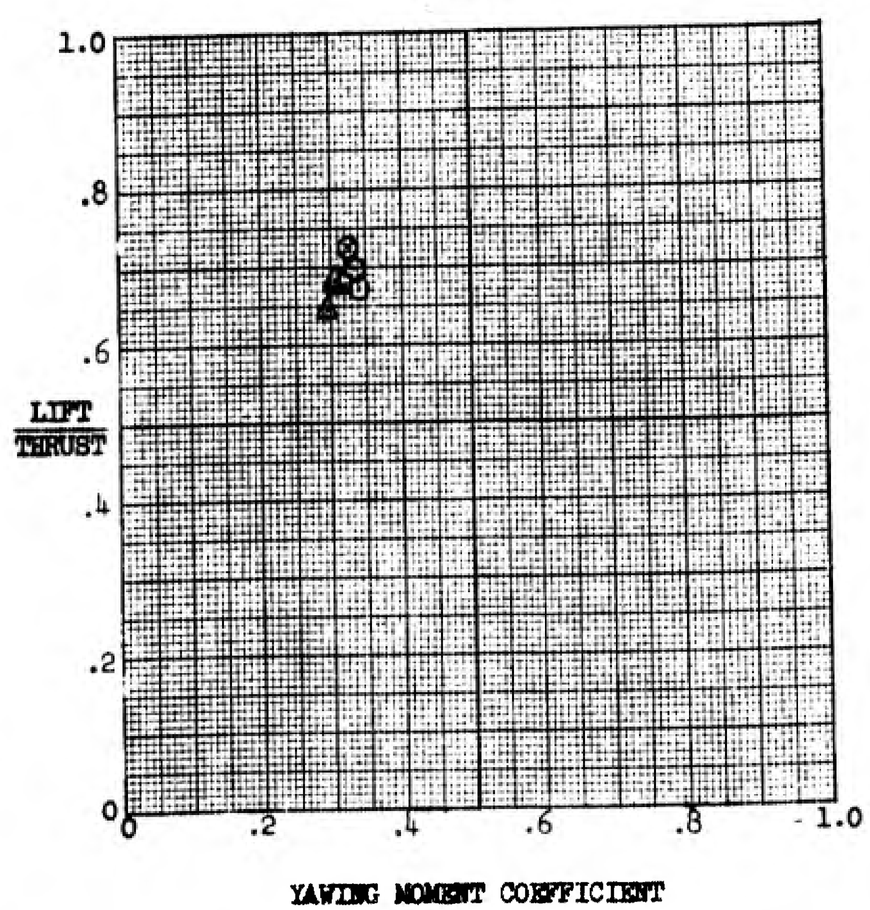
Figure 30

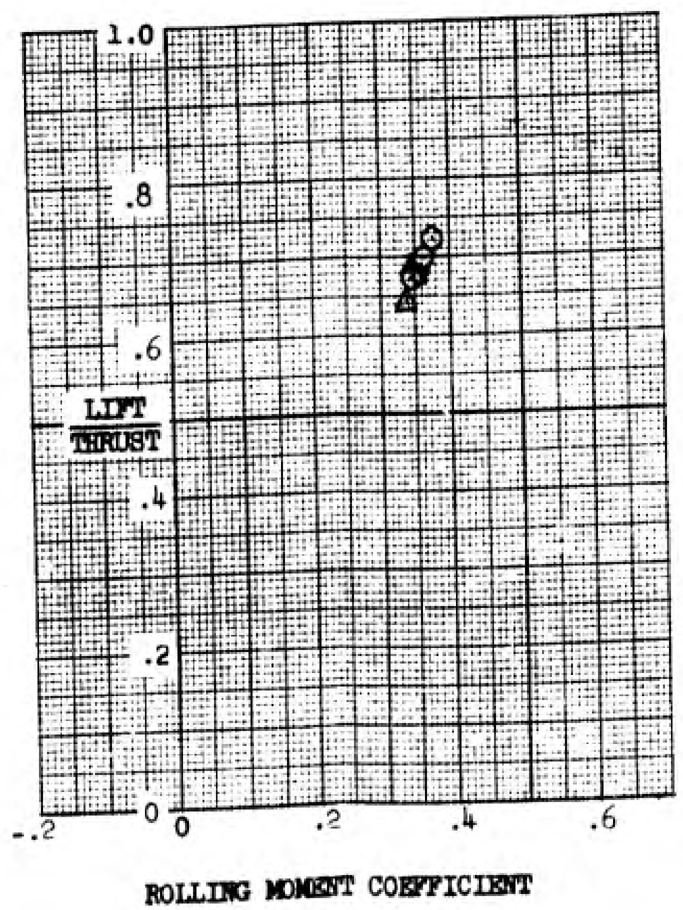
SYM	RUN	AFT FLAP
○	23	30°
△	24	40°











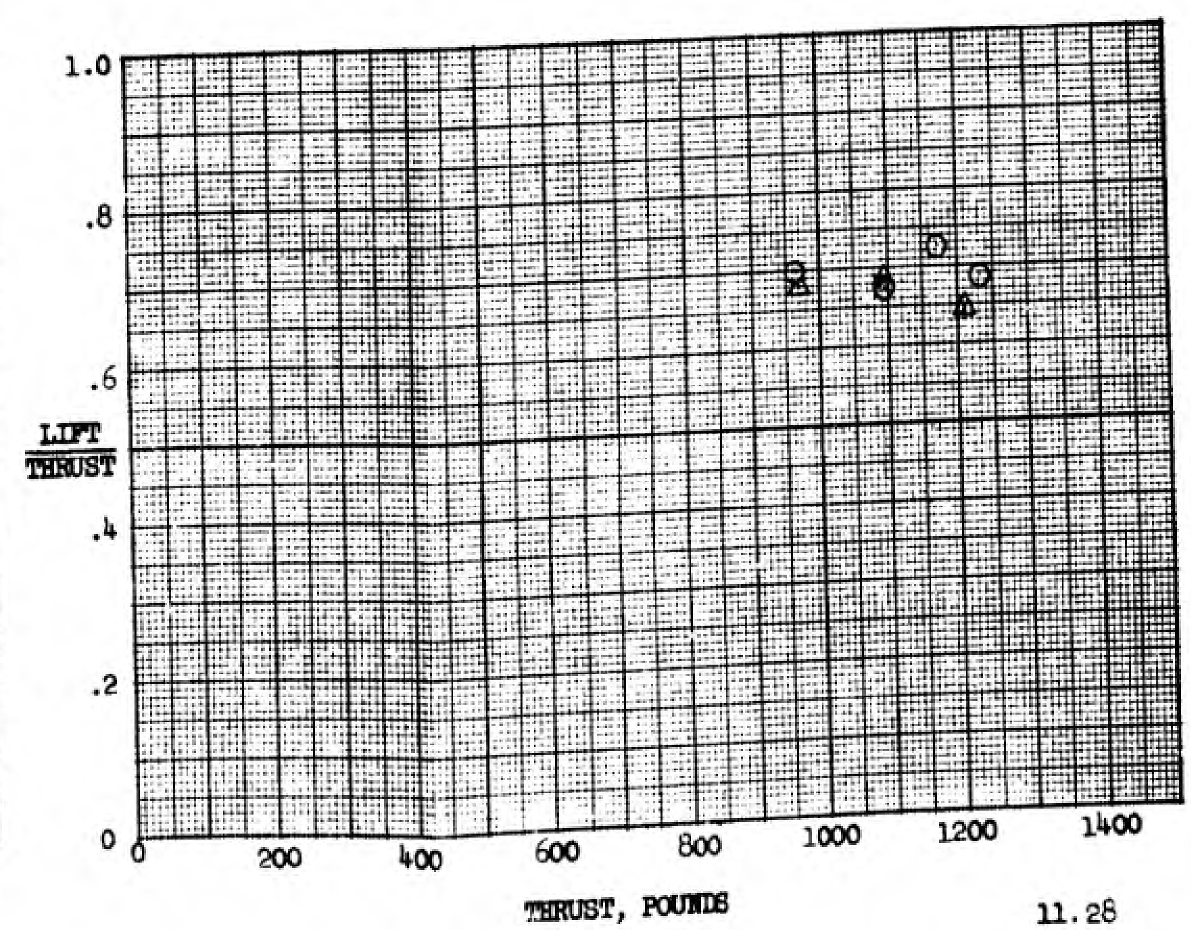


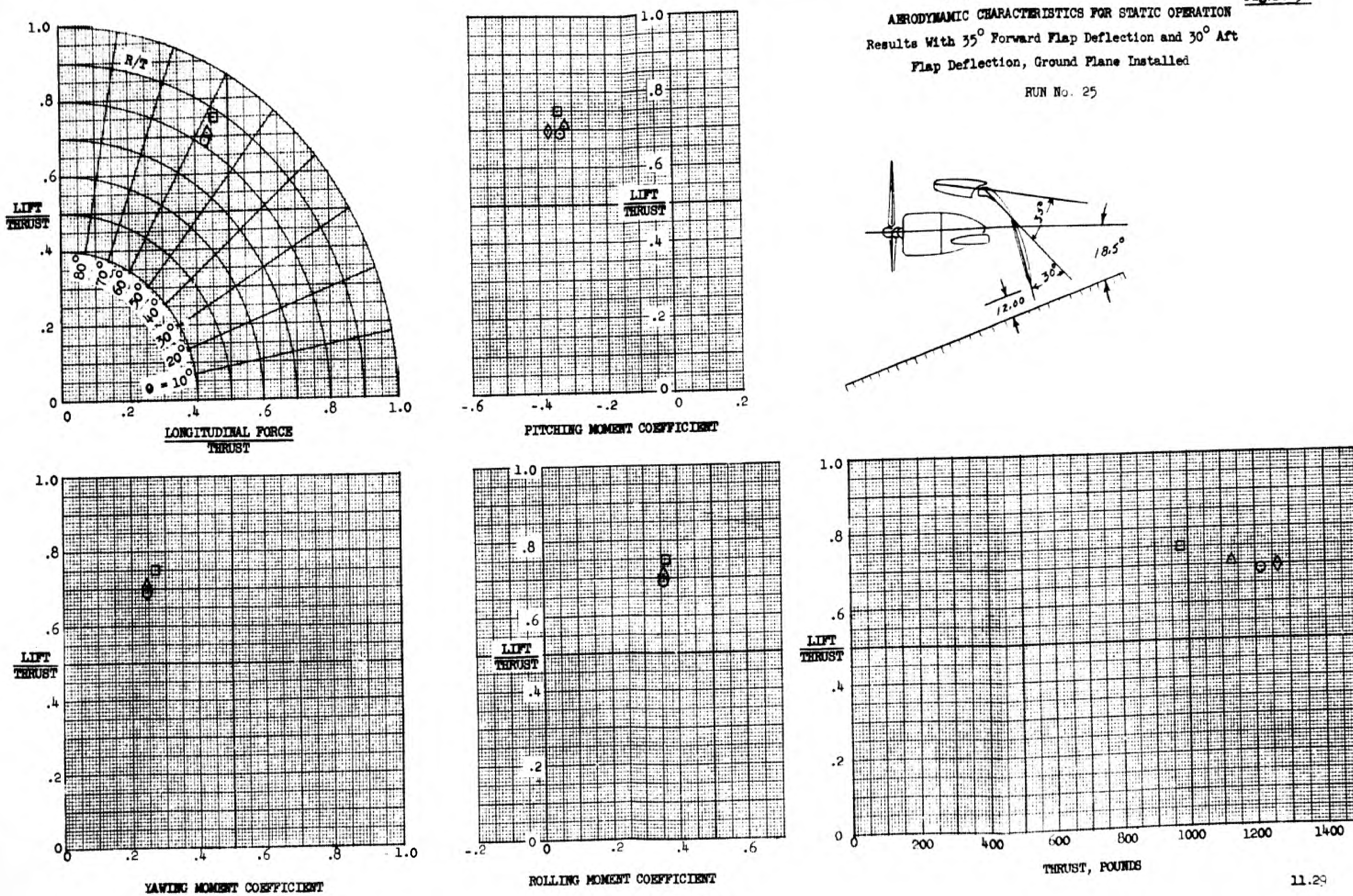
Figure 31

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Results With 35° Forward Flap Deflection and 30° Aft Flap Deflection, Ground Plane Installed

RUN No. 25



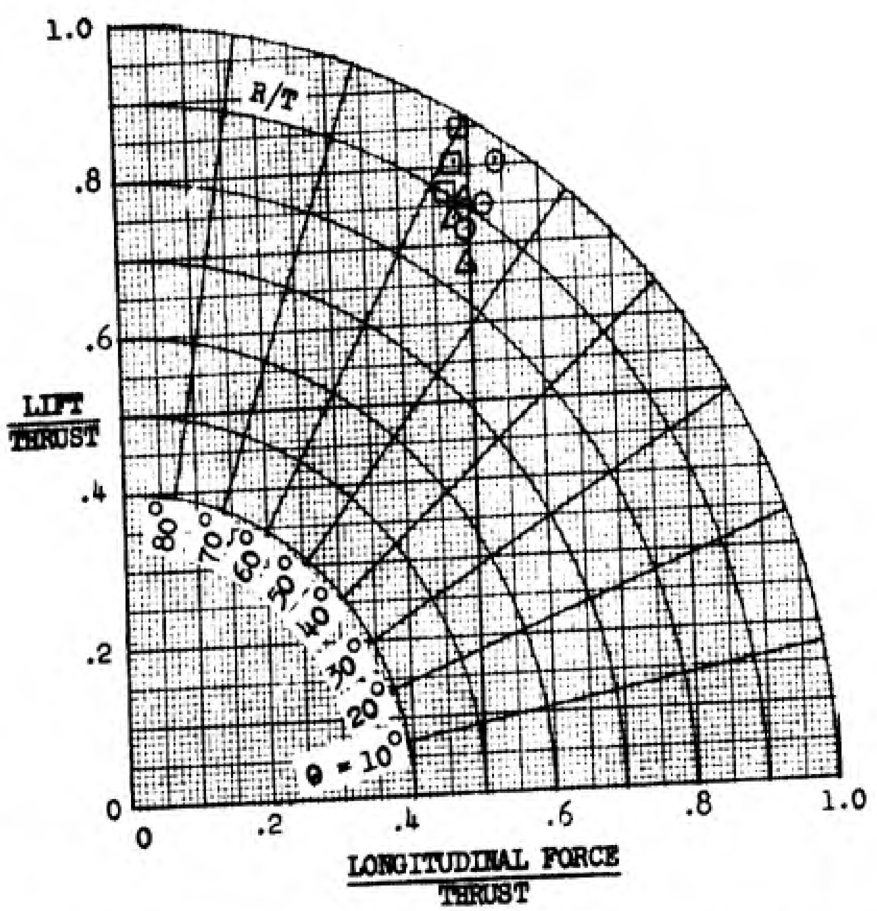
MODEL 88 MONOPLANE CONFIGURATION

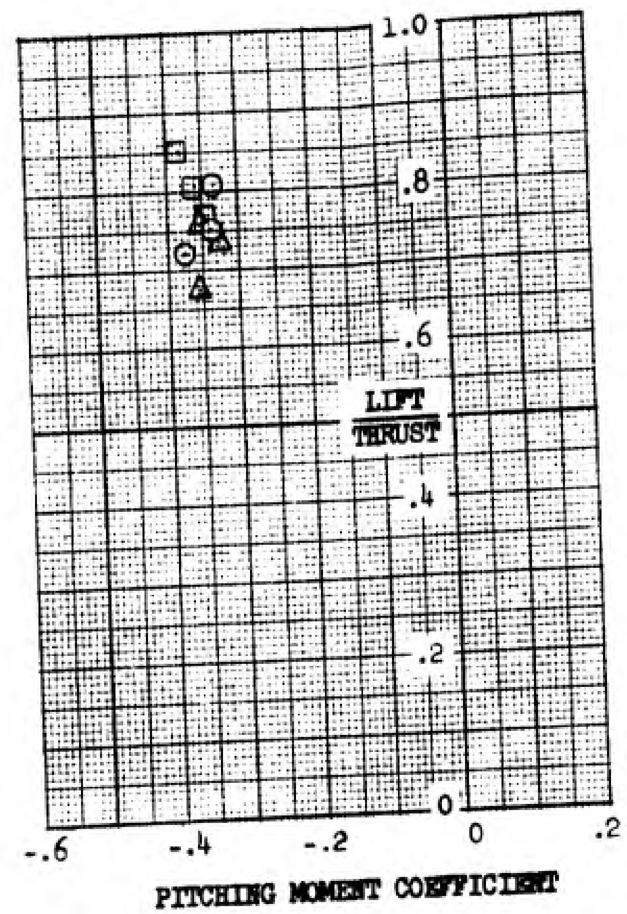
Figure 32

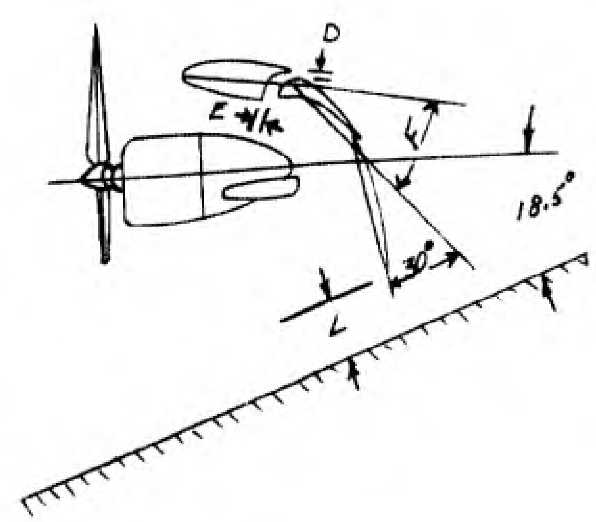
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

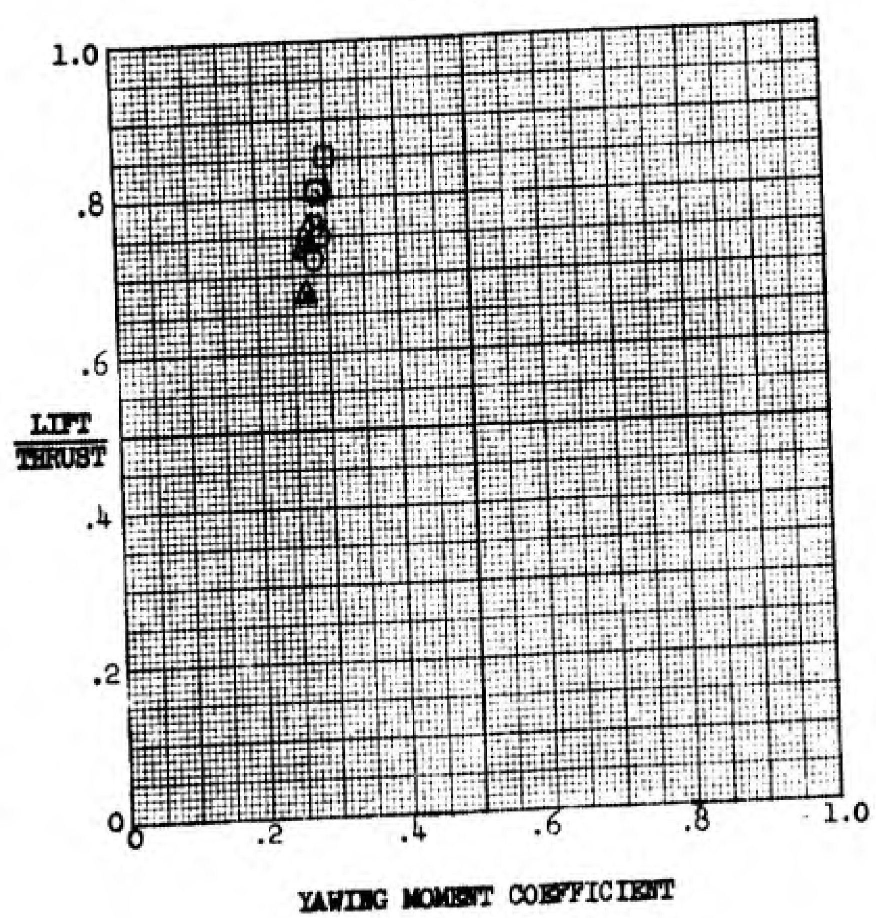
Effect of Forward Flap Placement (Horizontally and Vertically)
And Deflection With 30° Aft Flap Deflection, Ground Plane Installed

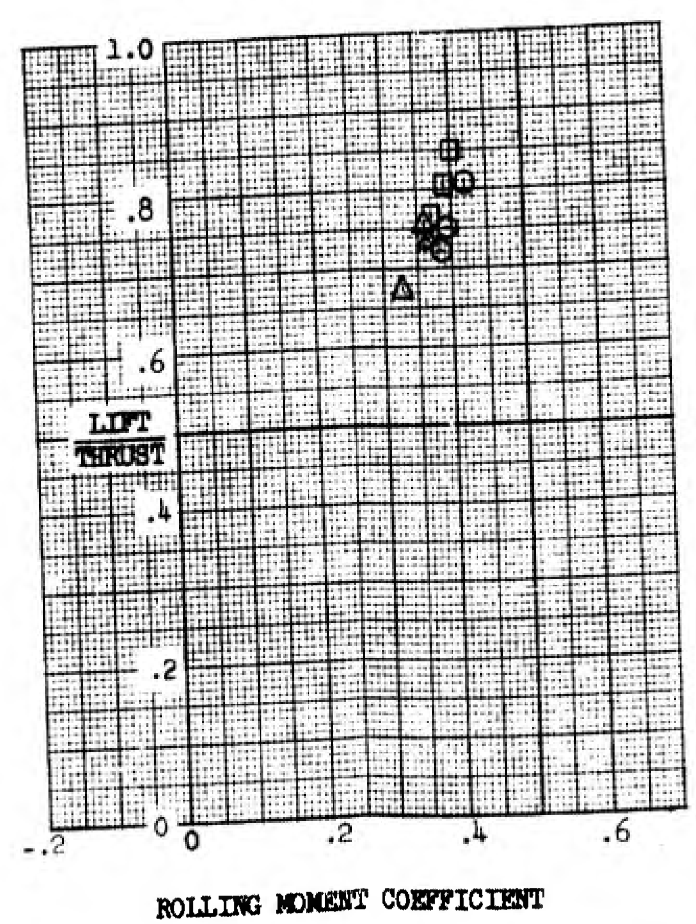
SYM	RUN	D	E	F
○	19	2.25	3.62	30
△	21	0.25	4.75	30
□	16	0.90	3.62	30

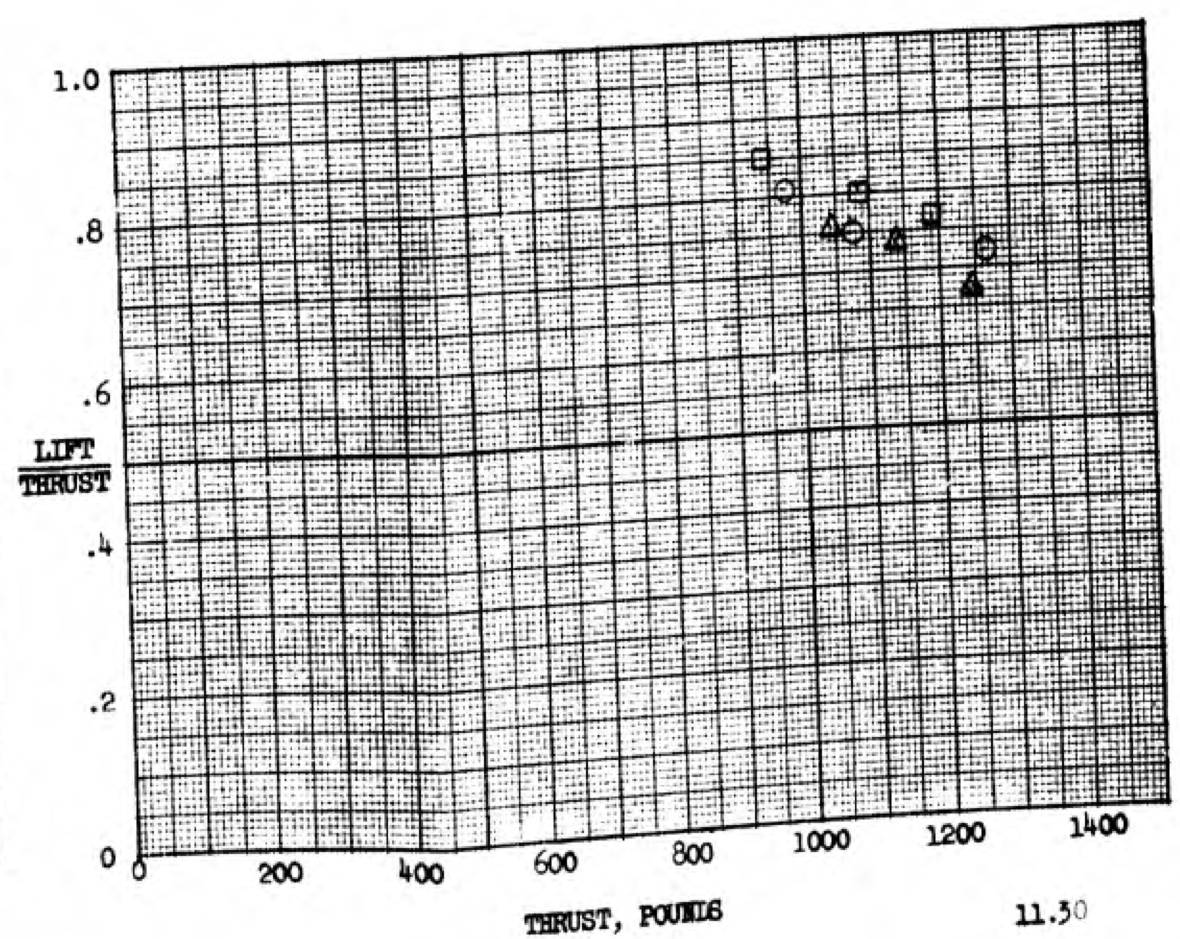












11.30

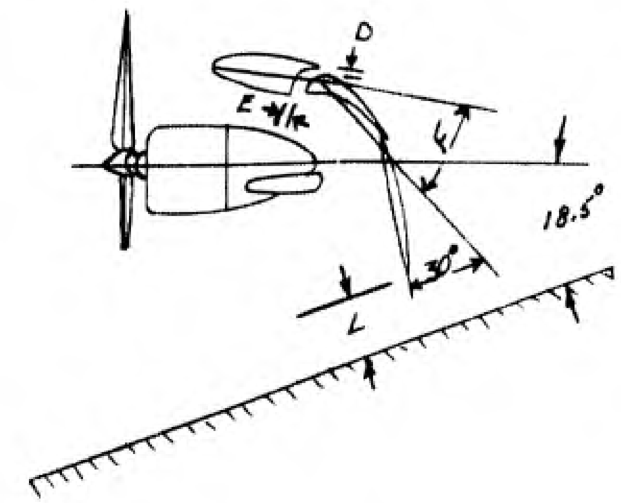
Figure 32

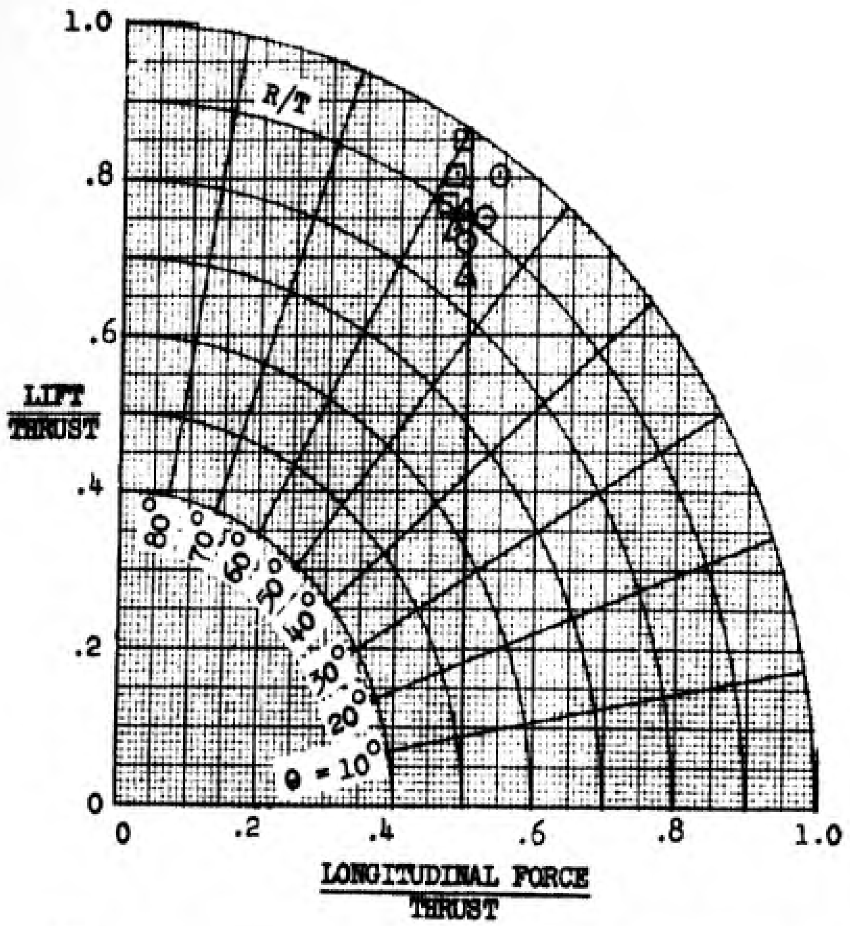
MODEL 88 MONOPLANE CONFIGURATION

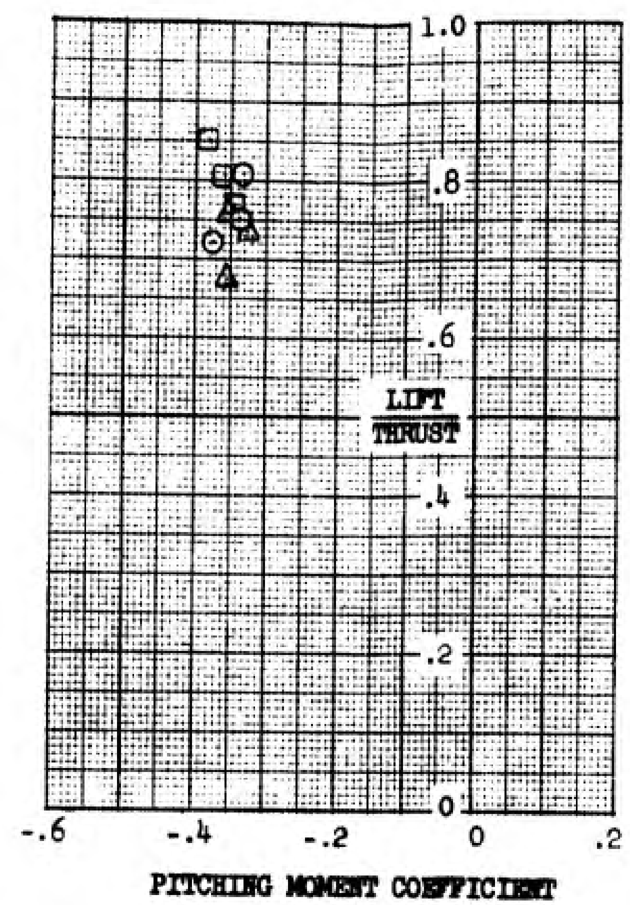
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

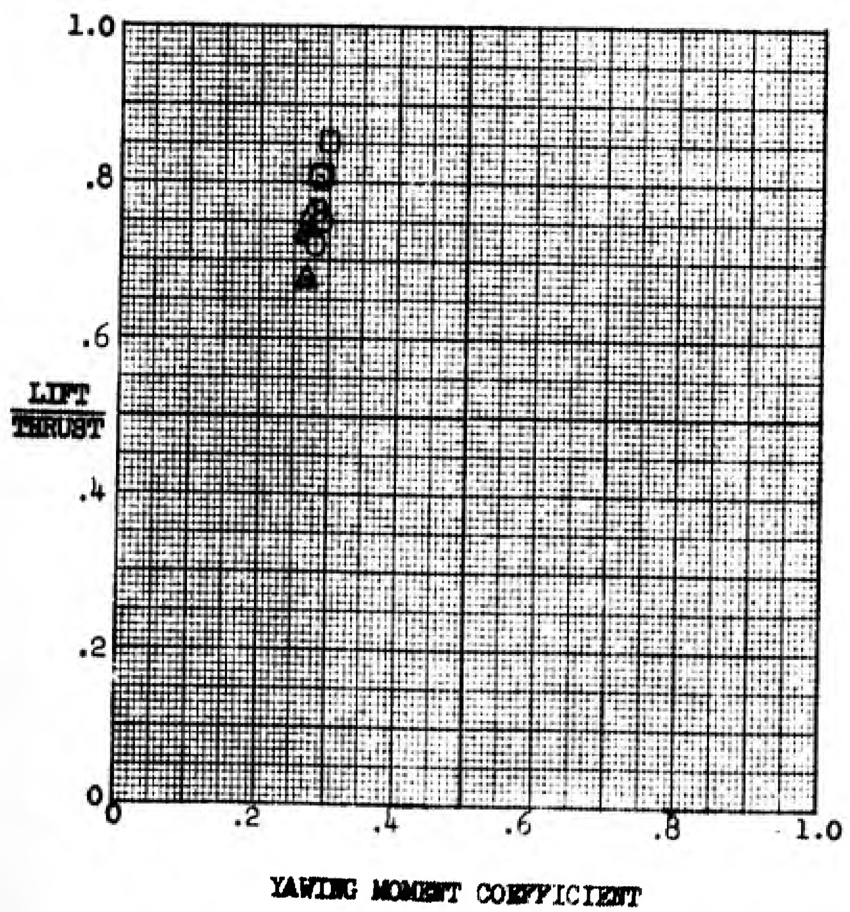
Effect of Forward Flap Placement (Horizontally and Vertically) And Deflection With 30° Aft Flap Deflection, Ground Plane Installed

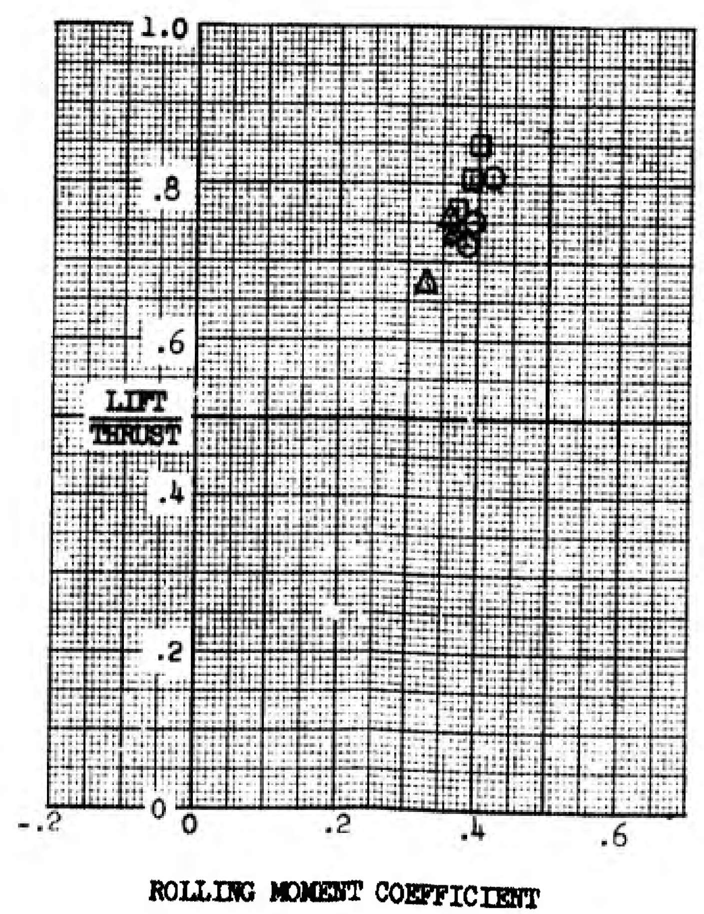
SYM	RUN	D	E	F
○	19	2.25	3.62	30
△	21	0.25	4.75	30
□	16	0.90	3.62	30

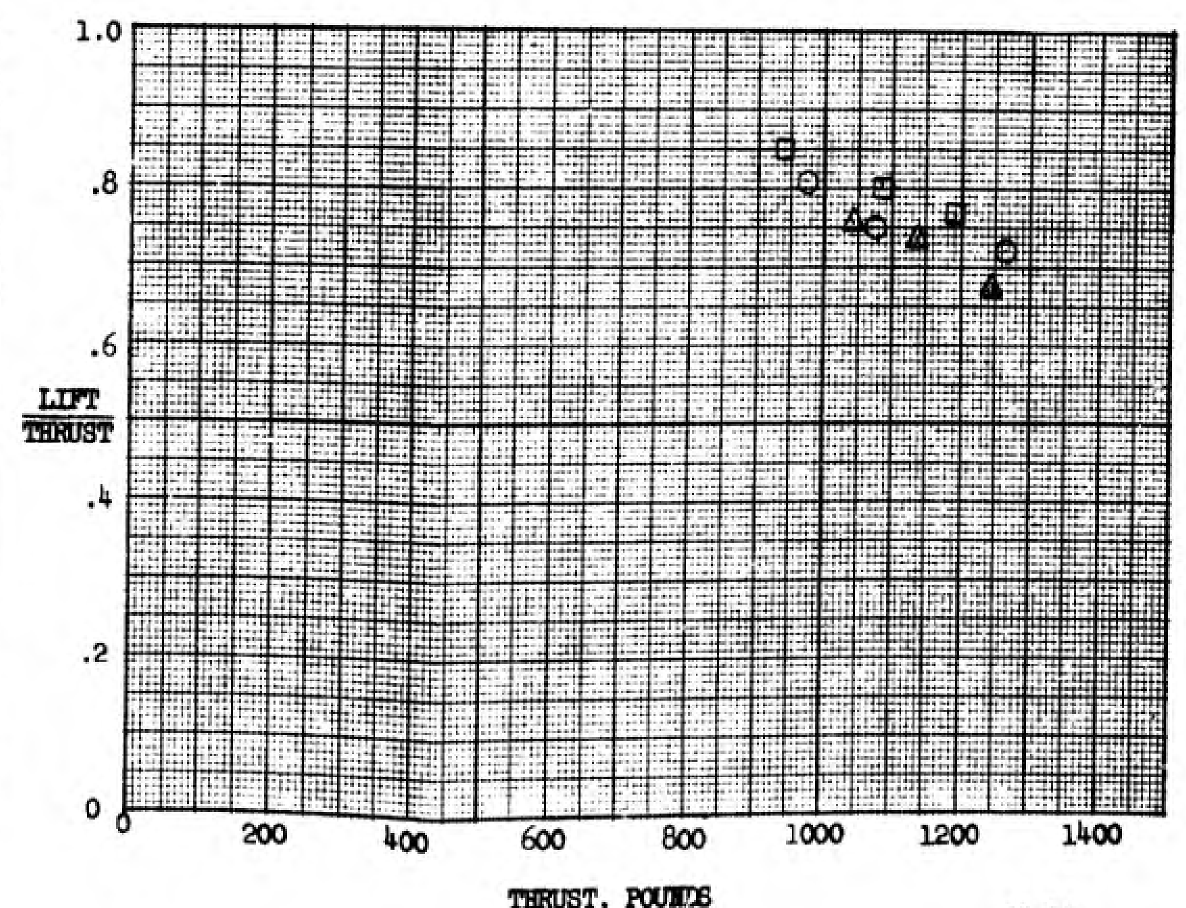












11.30

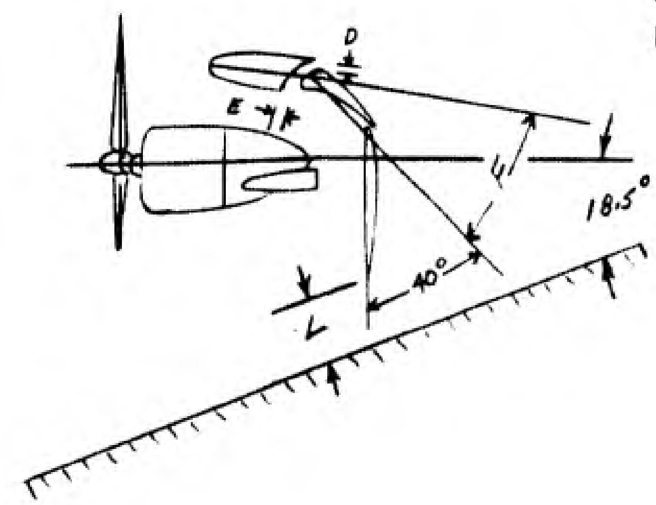
Figure 33

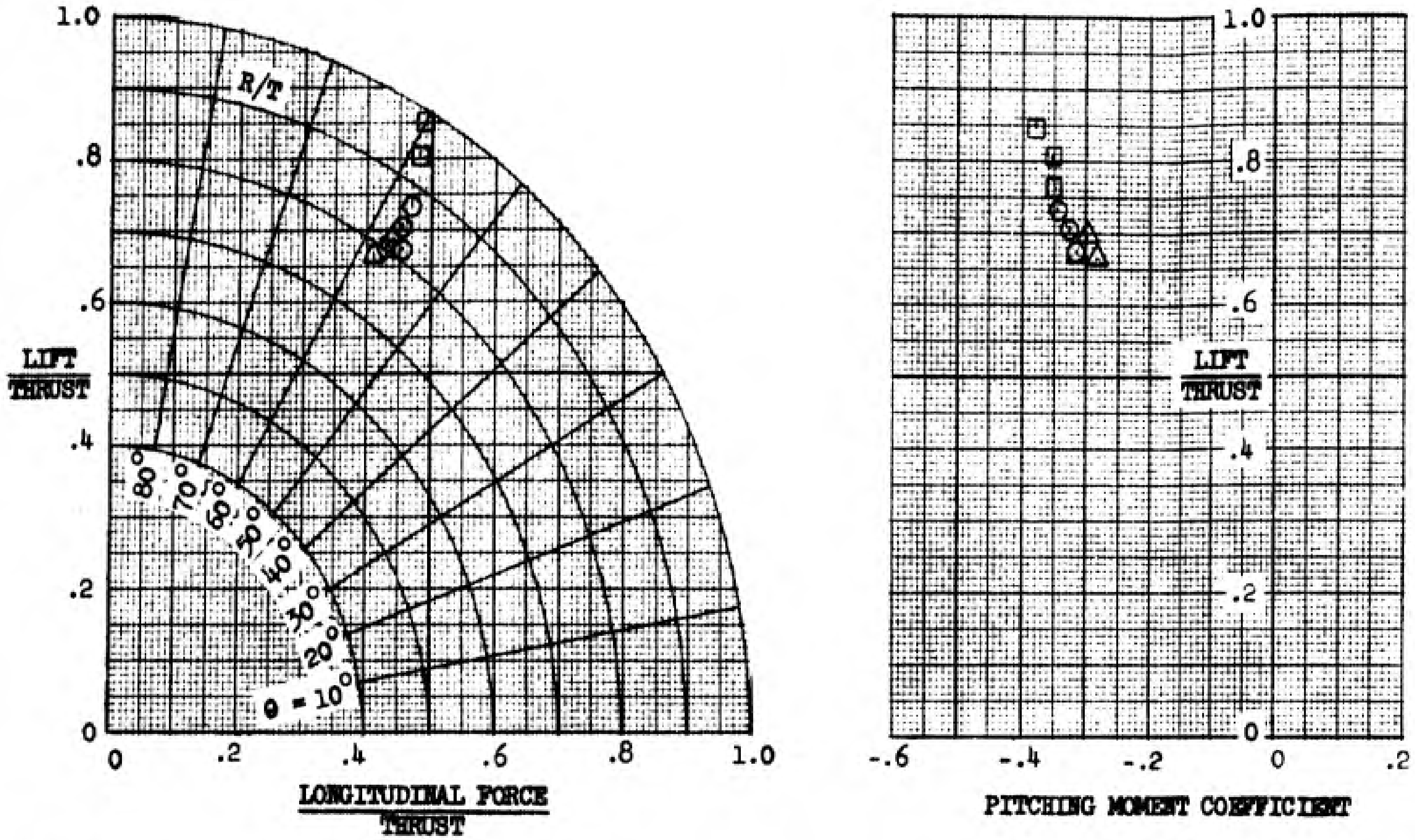
MODEL 88 MONOPLANE CONFIGURATION

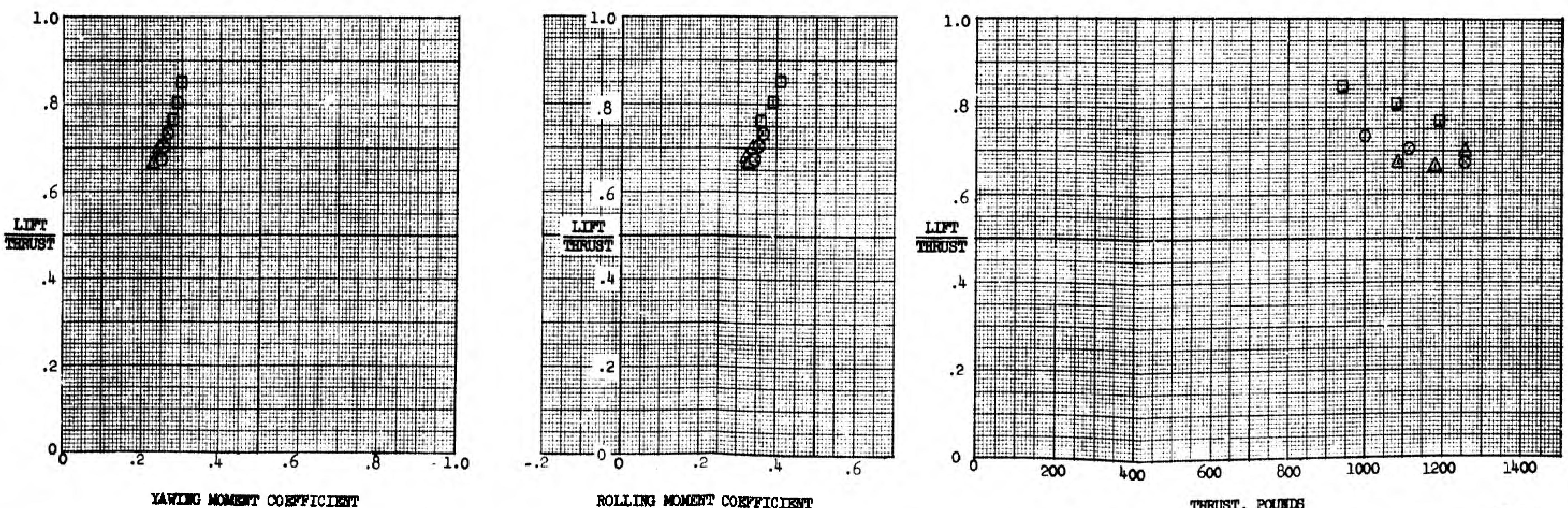
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Forward Flap Placement (Horizontally and Vertically) And Deflection With 40° Aft Flap Deflection, Ground Plane Installed

SYM	RUN	D	E	F
○	20	2.25	3.62	30
△	22	0.25	4.75	30
□	16	0.90	3.62	30







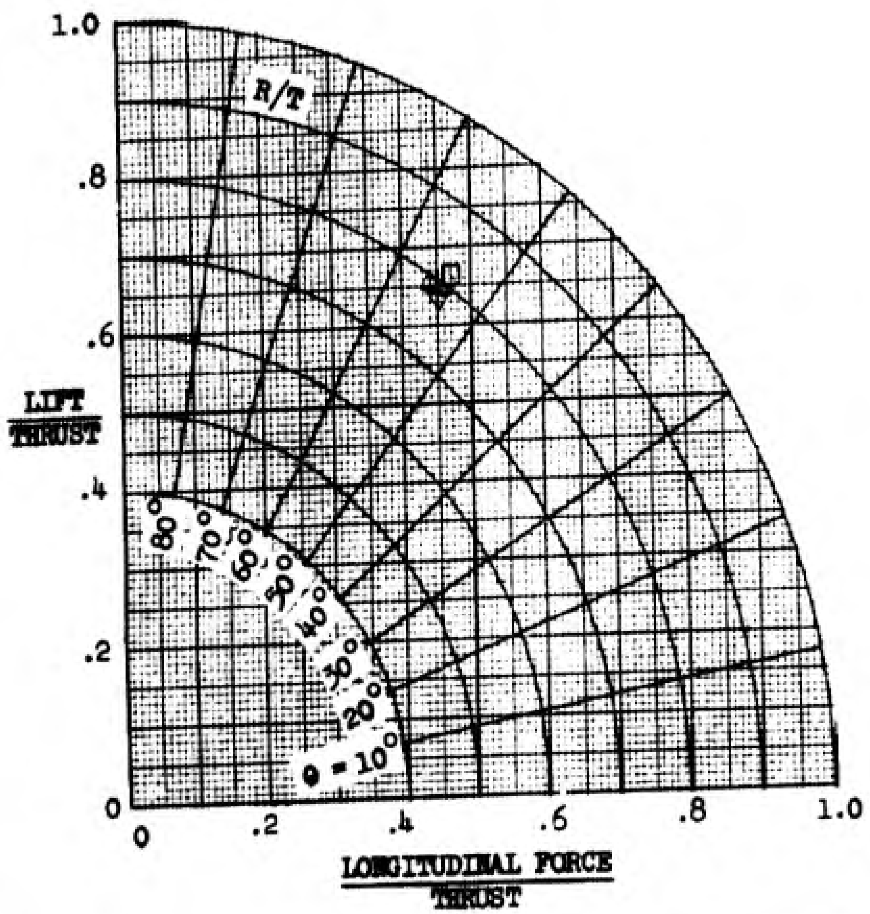
MODEL 88 MONOPLANE CONFIGURATION

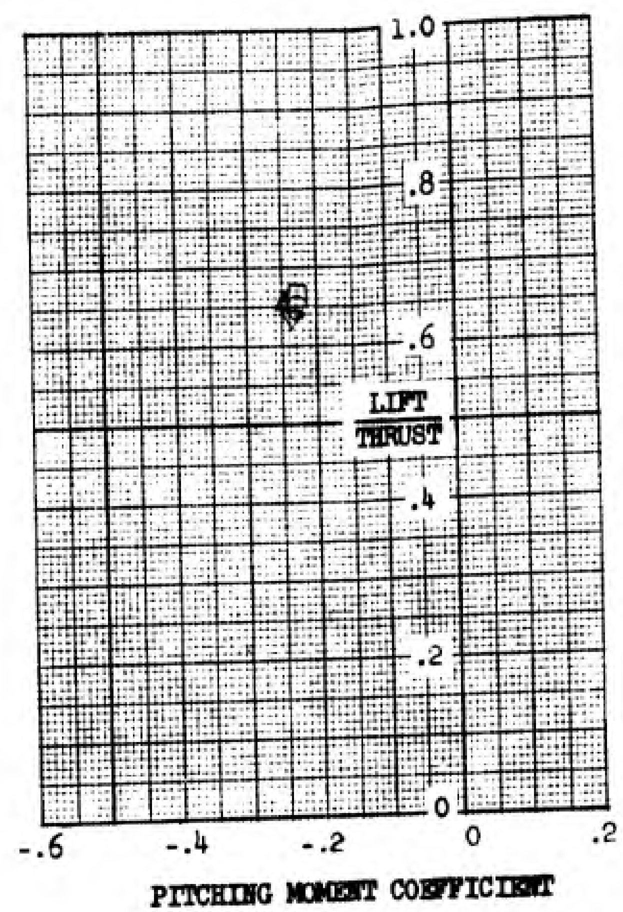
Figure 34

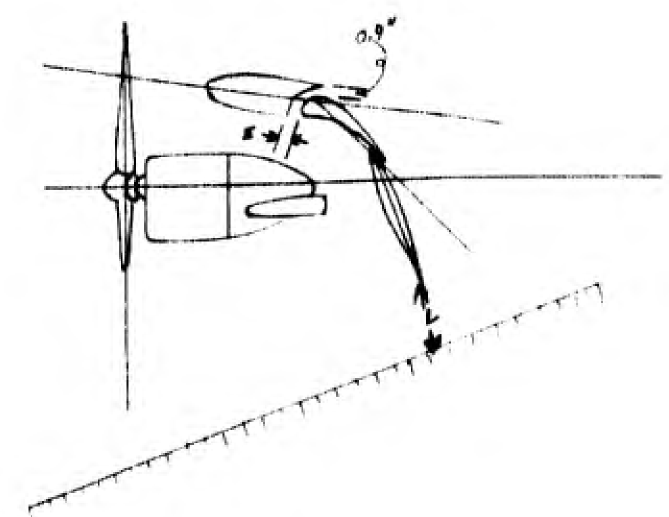
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

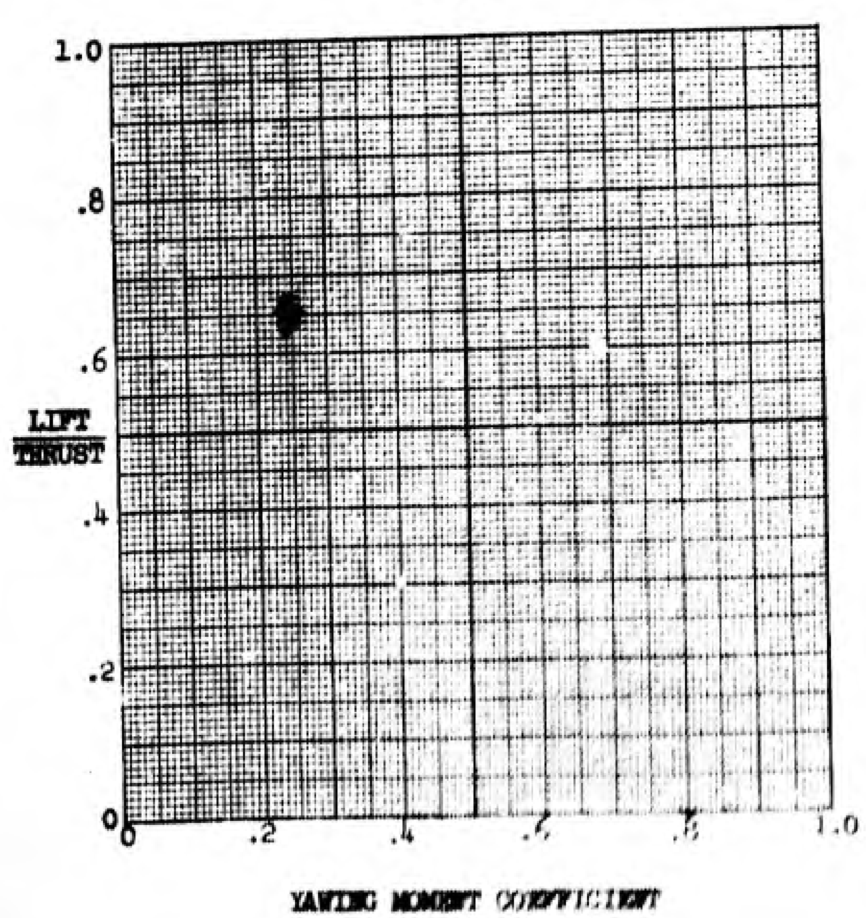
Effect of Gap Between Wing and Forward Flap With Wing at 13° Angle of Incidence
Forward Flap Deflected 35° and Aft Flap Deflected 25°, Ground Plane Installed

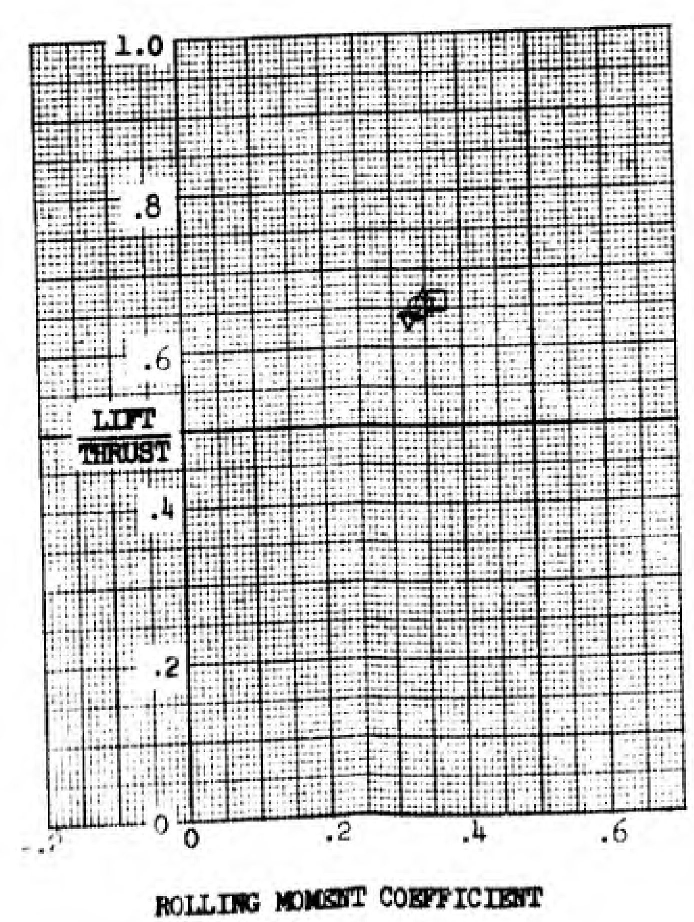
SYM	RUN	E	L
○	77.1	6.900	9.25
△	77.2	6.900	9.25
□	77.3	5.625	9.75
▽	77.4	5.625	9.75











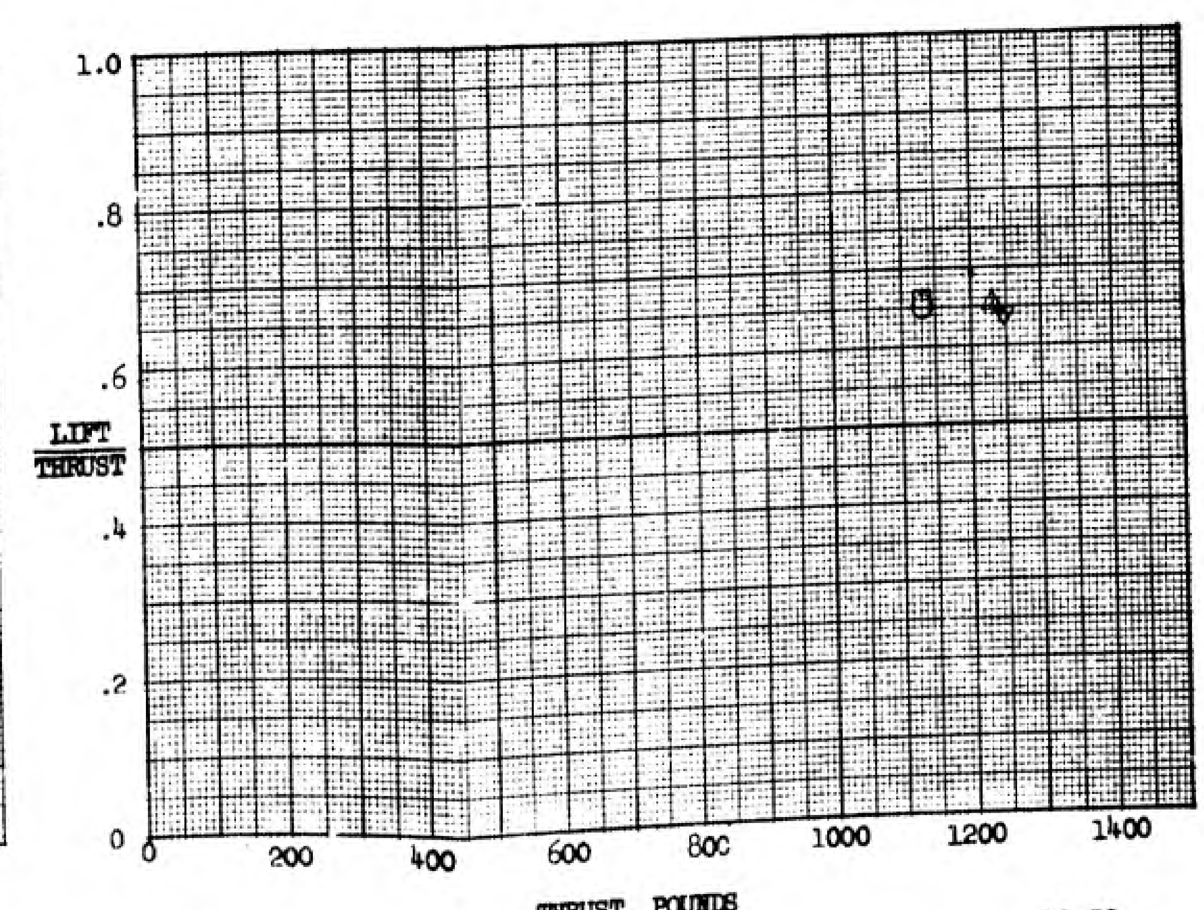


Figure 35

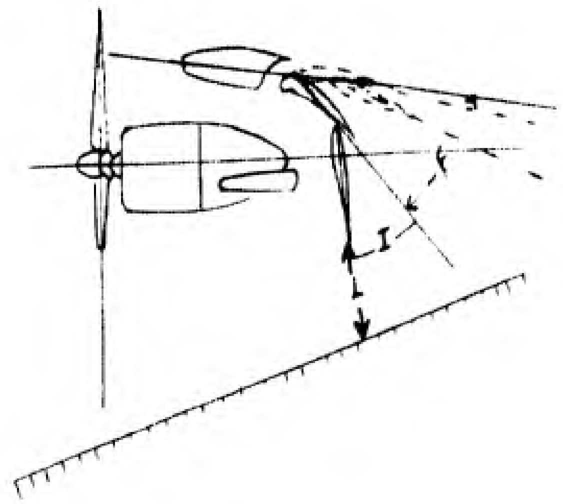
MODEL 88 MONOPLANE CONFIGURATION

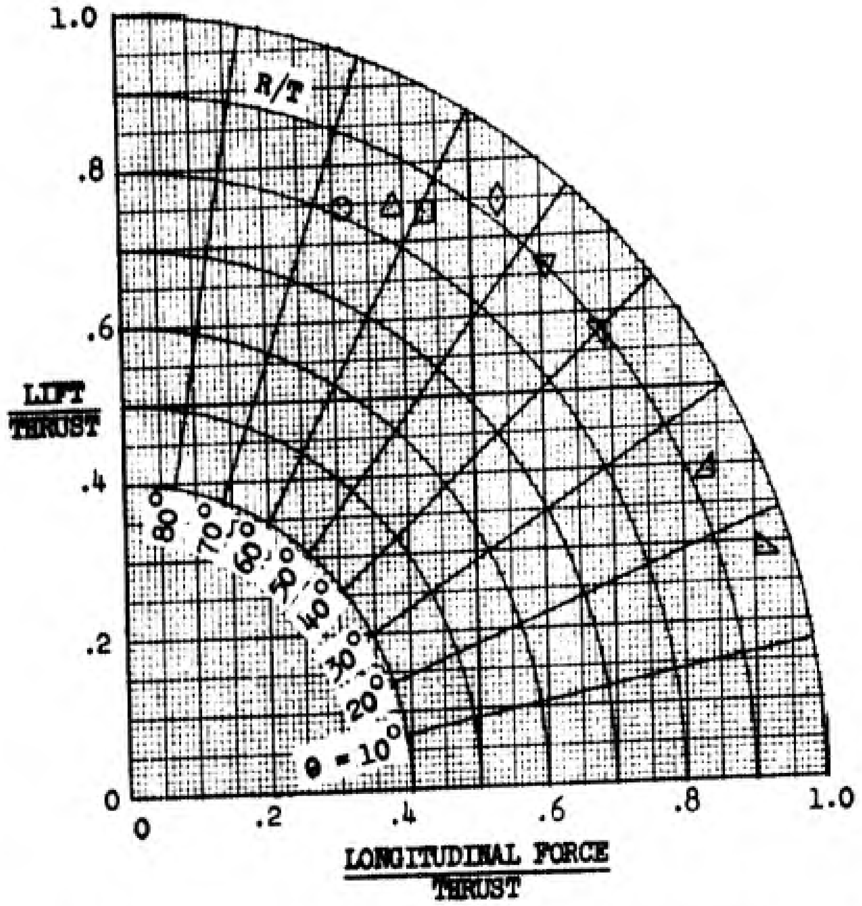
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

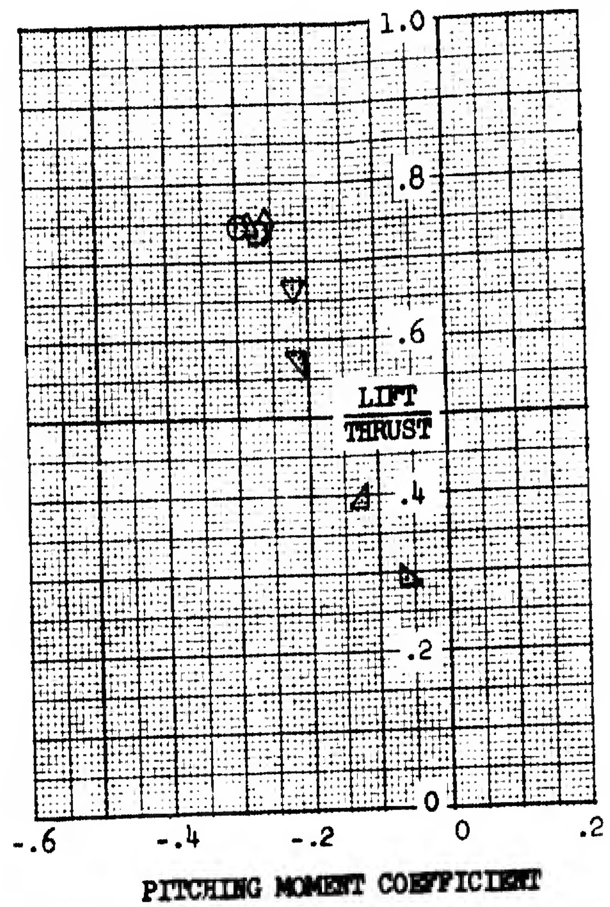
Effect of Retracting Flaps in a Typical Take-Off Sequence With Wing at 13°

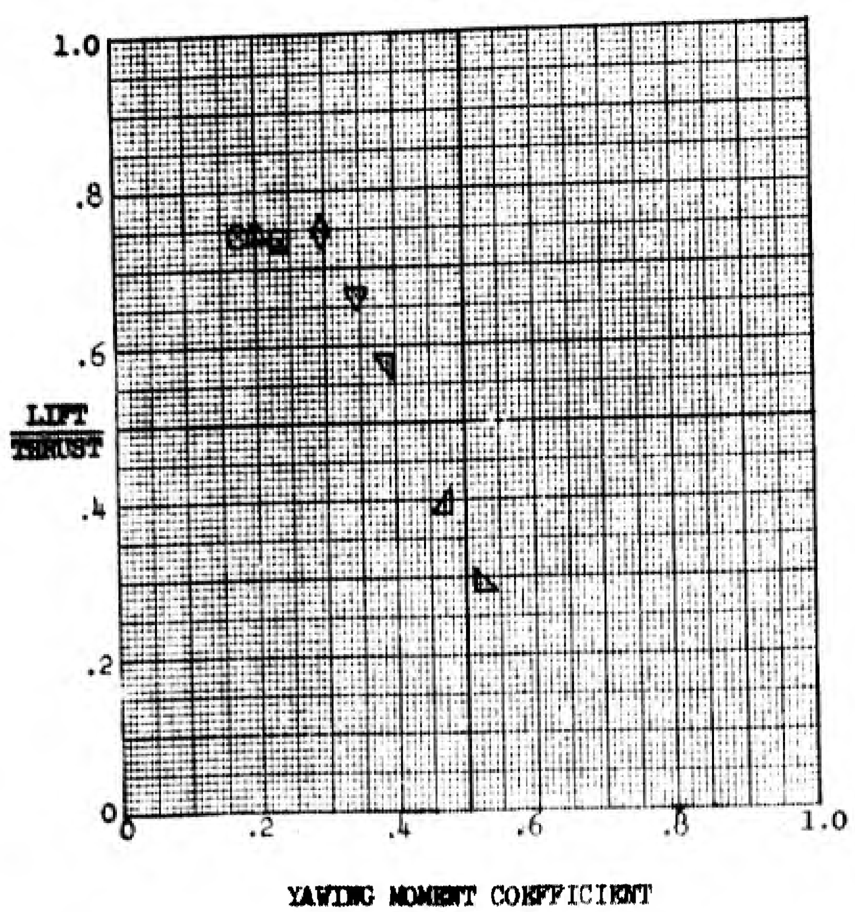
Angle of Incidence, Ground Plane Installed

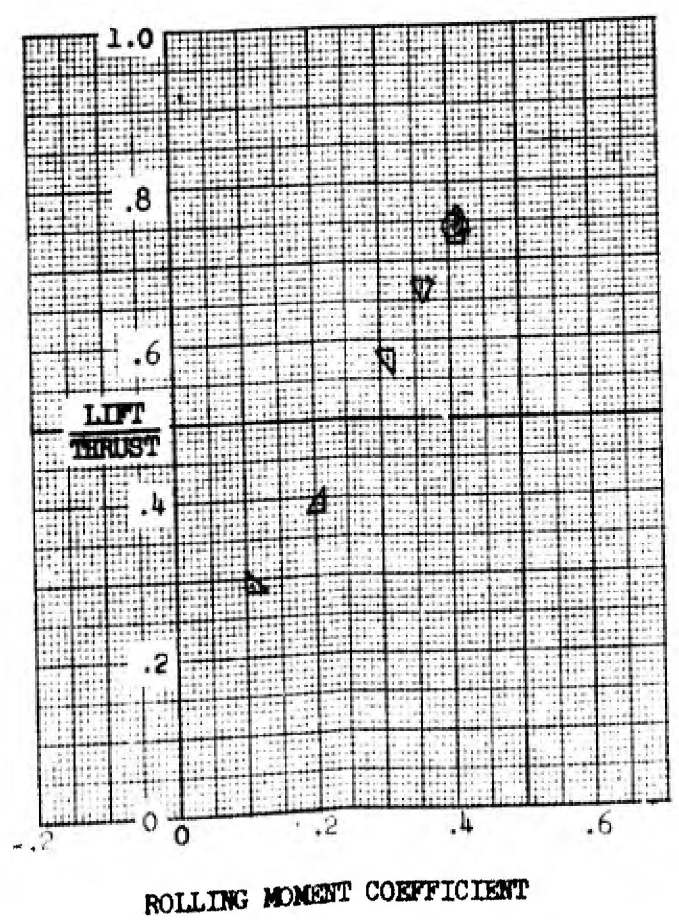
SYM	RUN	F	I	L
○	78.1	40.0	36.0	6.50
△	78.2	35.0	35.0	9.13
□	78.3	30.0	33.5	12.13
◇	78.4	25.0	31.0	16.63
▽	78.5	20.0	28.5	22.00
◁	78.6	15.0	25.0	26.50
◿	78.7	8.5	18.0	37.75
◺	78.8	4.0	12.0	45.50











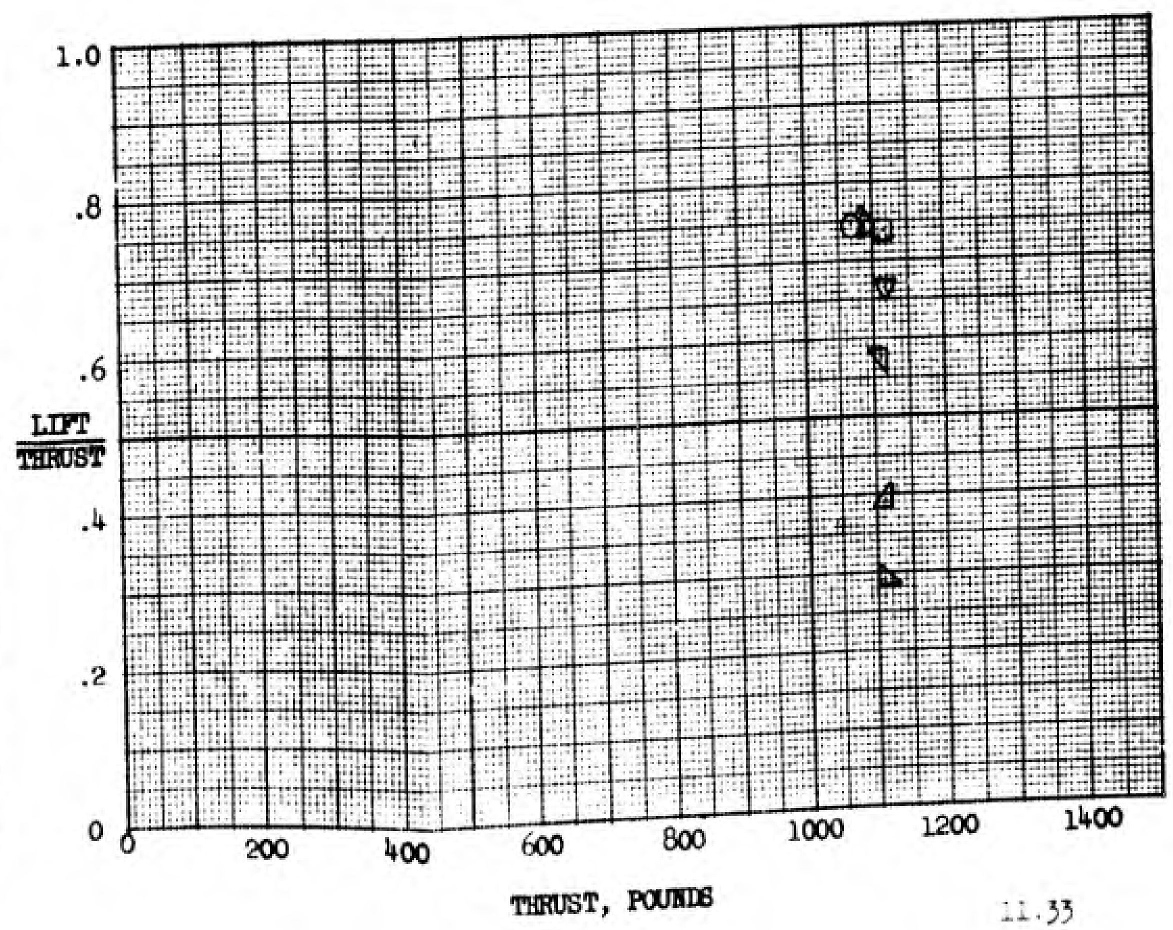


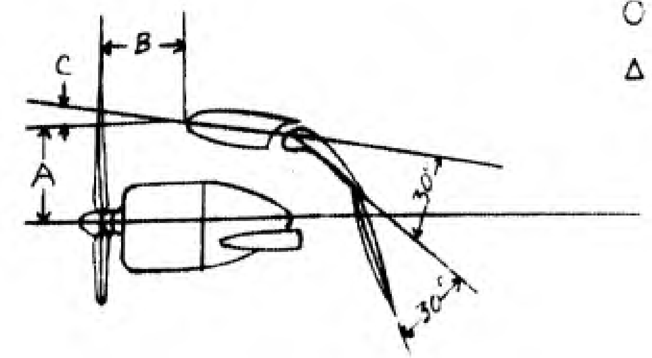
Figure 36

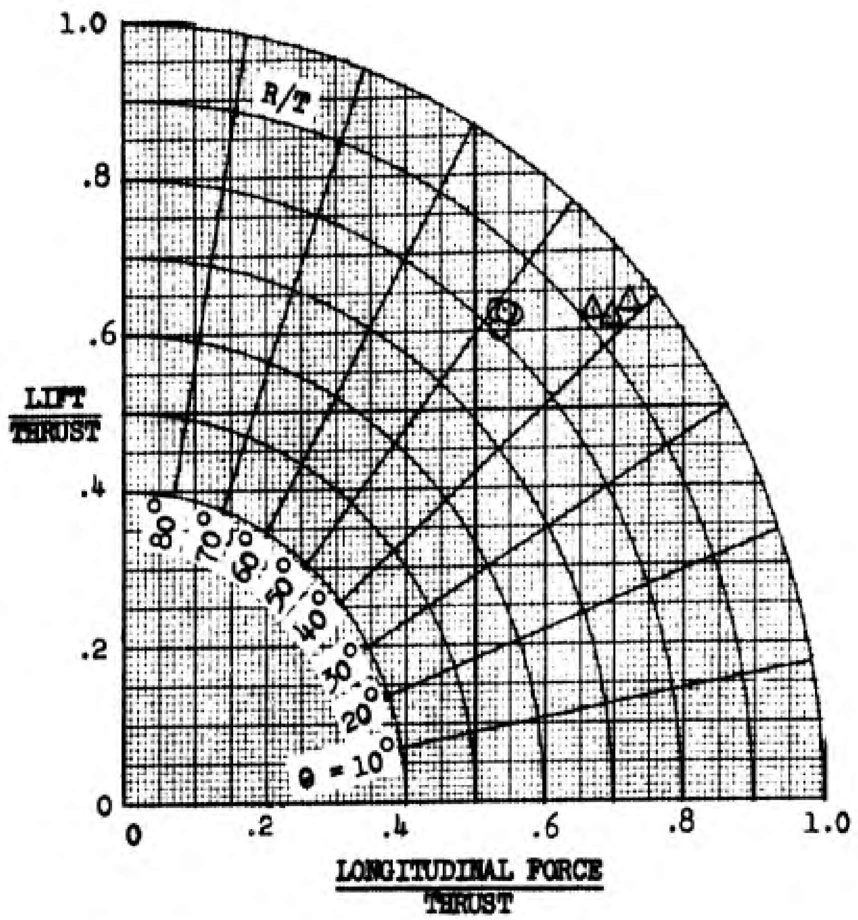
MODEL 88 MONOPLANE CONFIGURATION

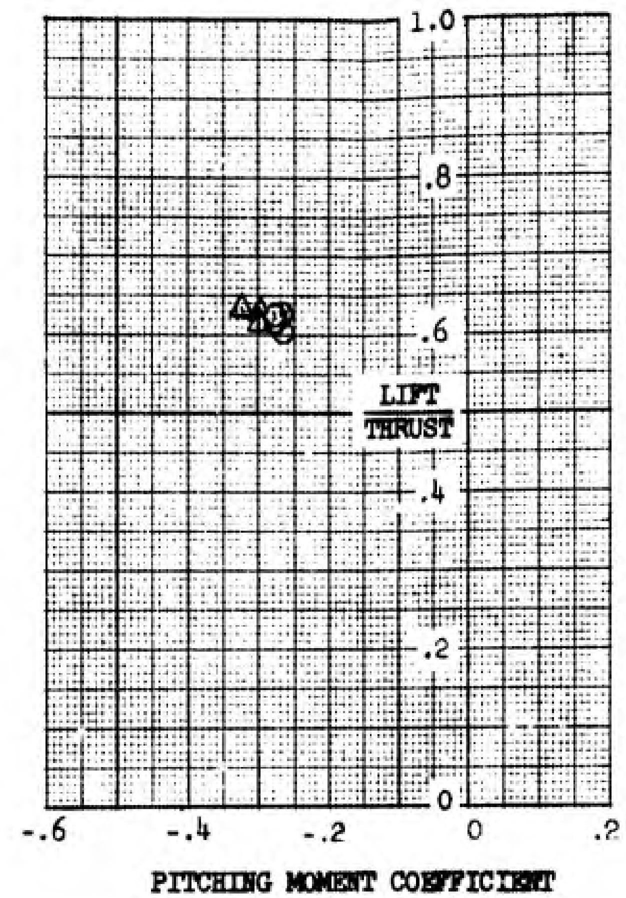
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

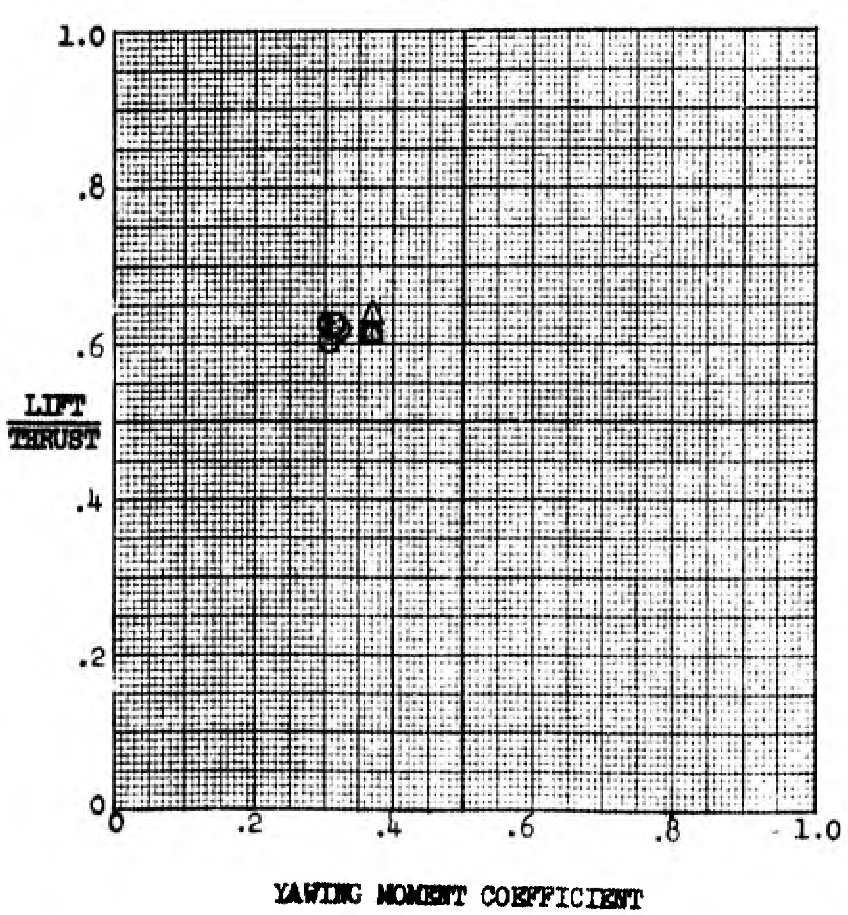
Effect of Wing Location With 30° Forward and Aft Flap Deflection, Ground Plane Not Installed

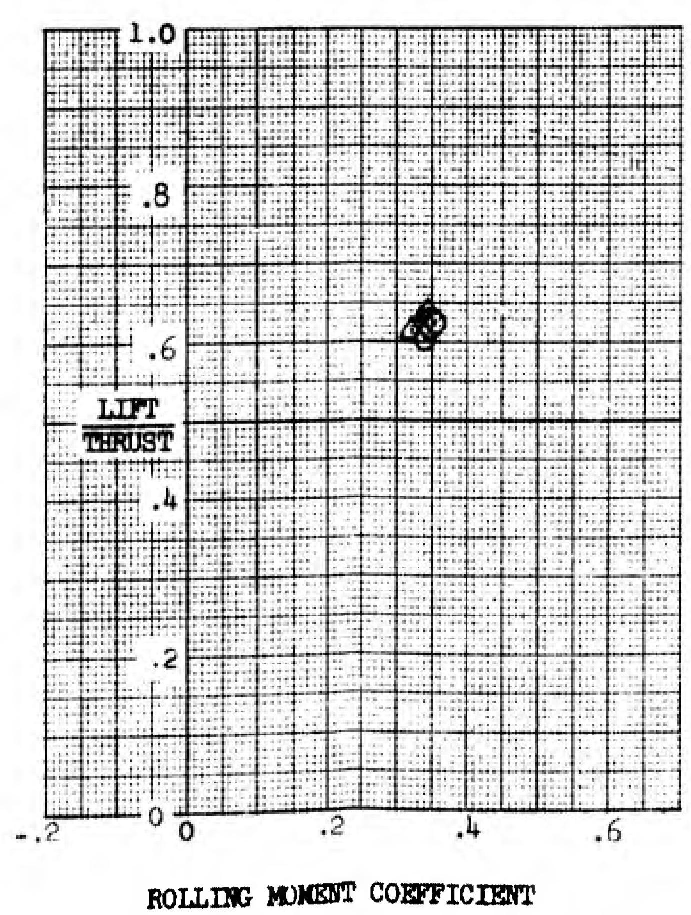
SYM	RUN	A	B	C
○	41	25.34	28.62	8.75
△	43	8.00	58.20	8.75











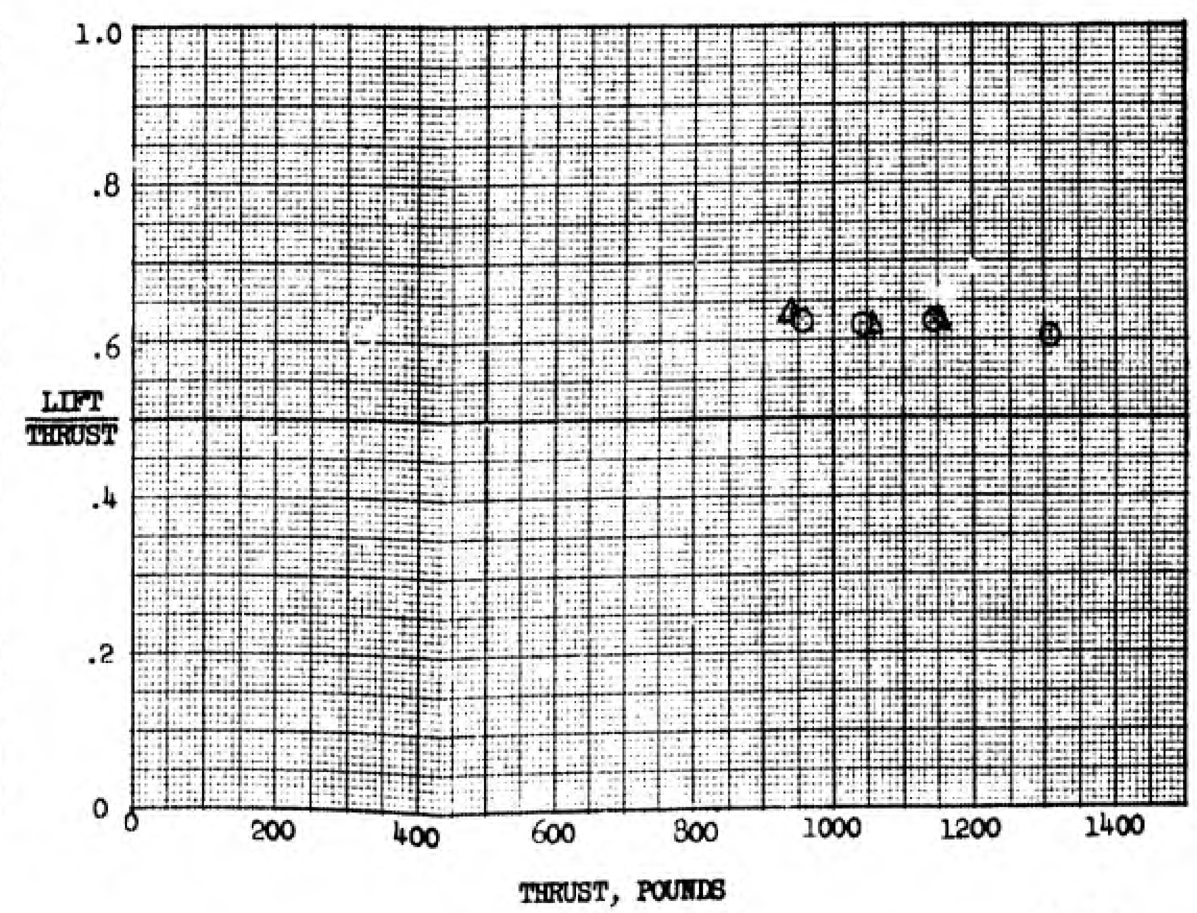


Figure 37

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Wing Location With 30° Forward and Aft Flap Deflection, Ground Plane Installed

SYM	RUN	A	B	C
○	27	26.00	29.25	13
△	32	18.50	26.12	13

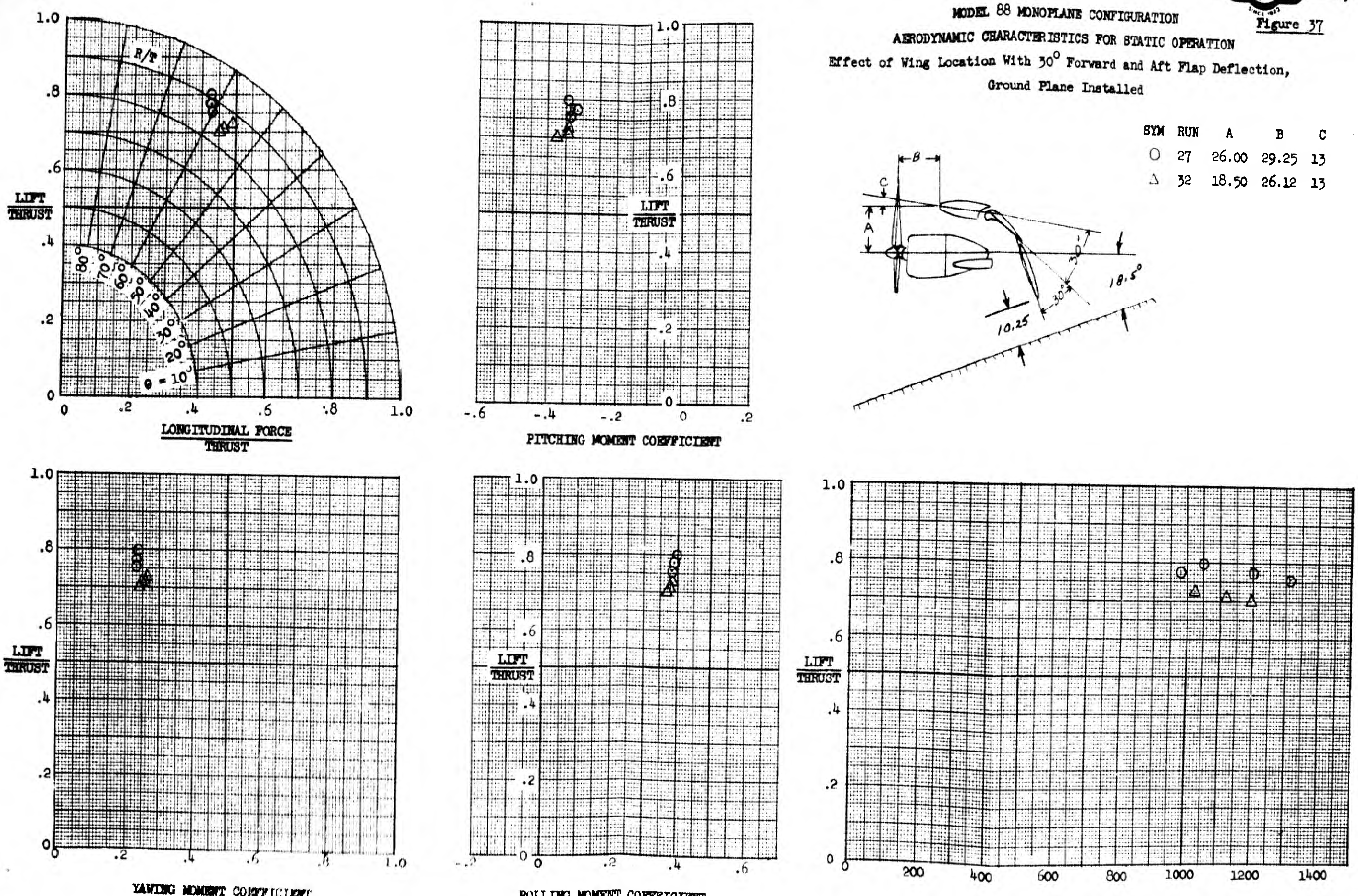


Figure 38

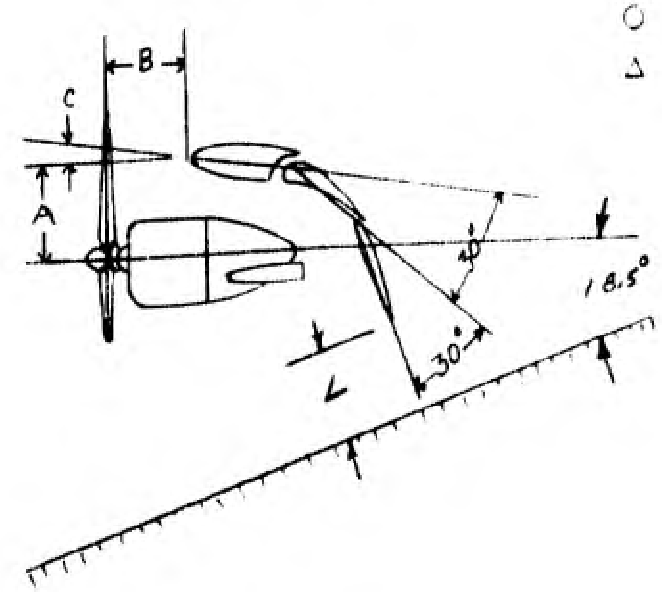
MODEL 88 MONOPLANE CONFIGURATION

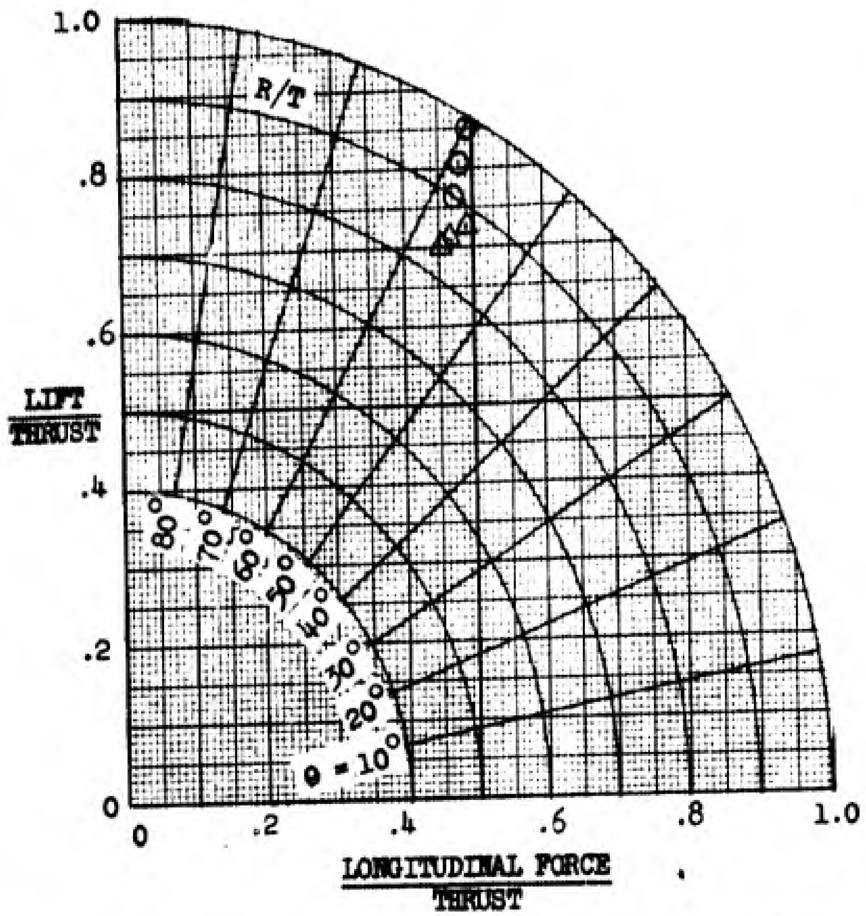
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

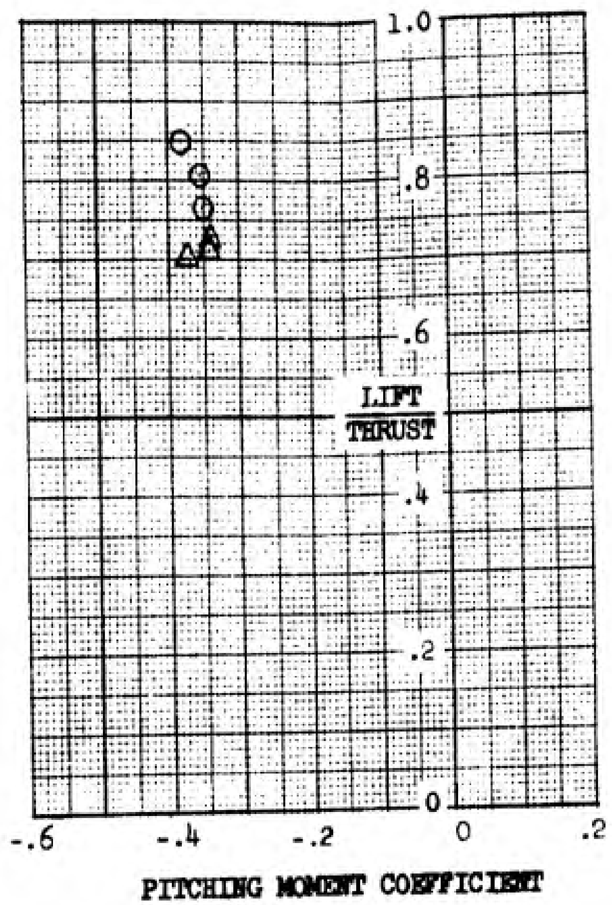
Effect of Wing Location and Angle of Incidence

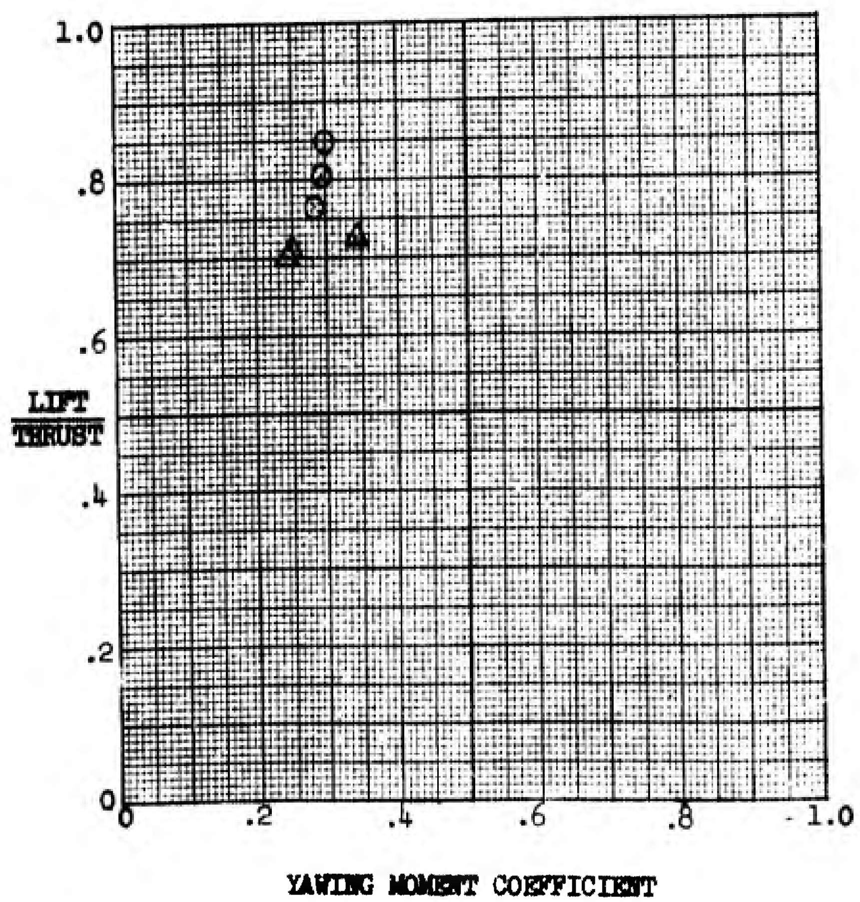
With 30° Forward and Aft Flap Deflection, Ground Plane Installed

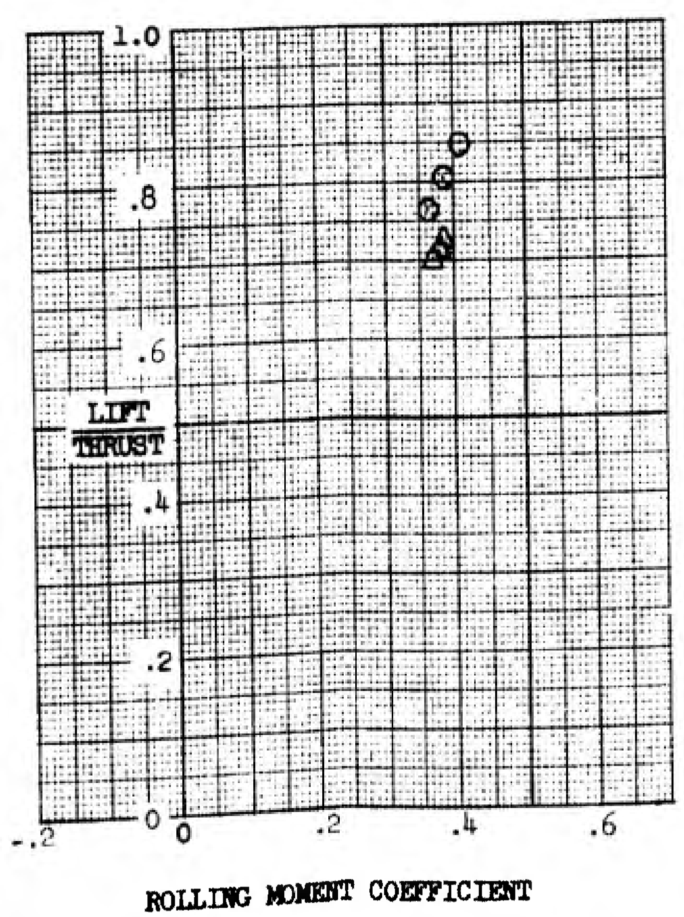
SYM	RUN	A	B	C
○	16	25.34	28.62	8.75
△	32	18.50	26.12	13.00











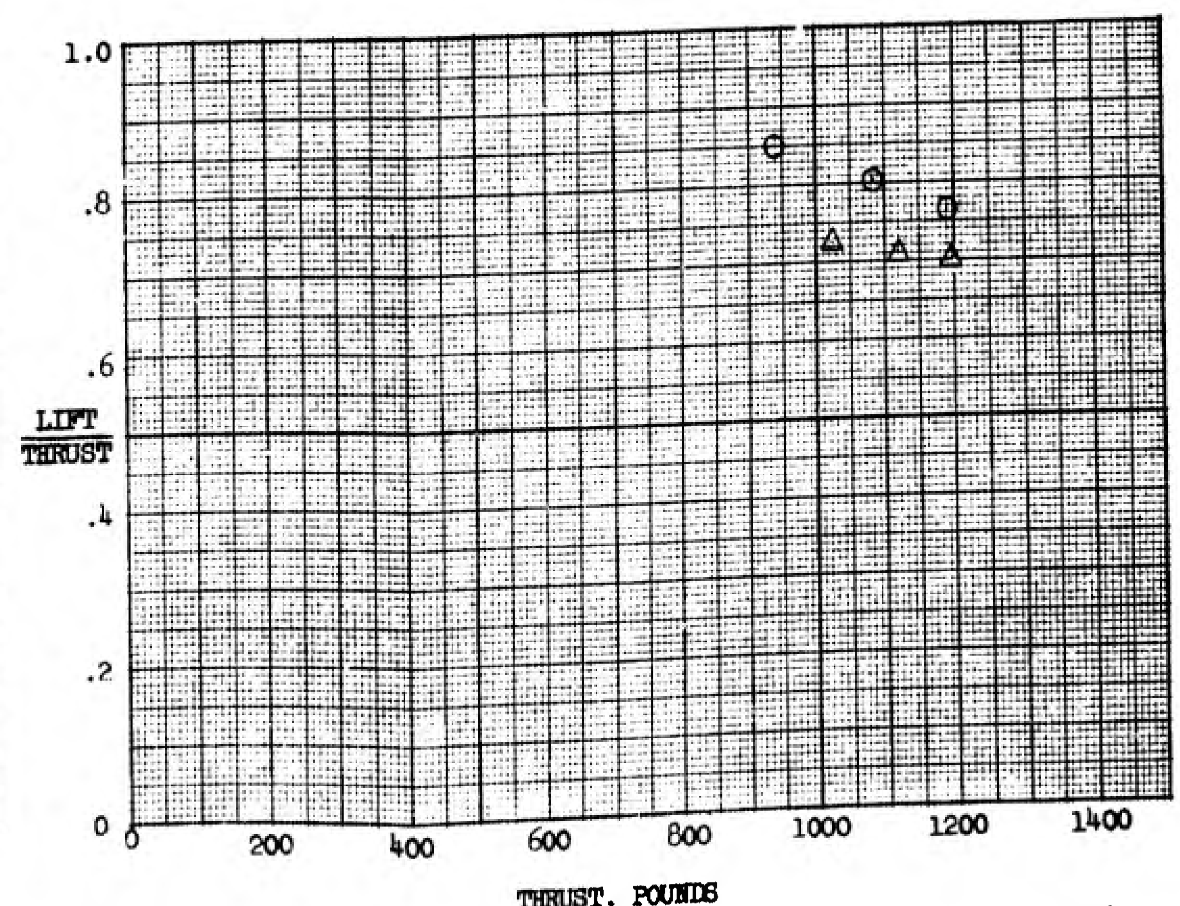


Figure 39

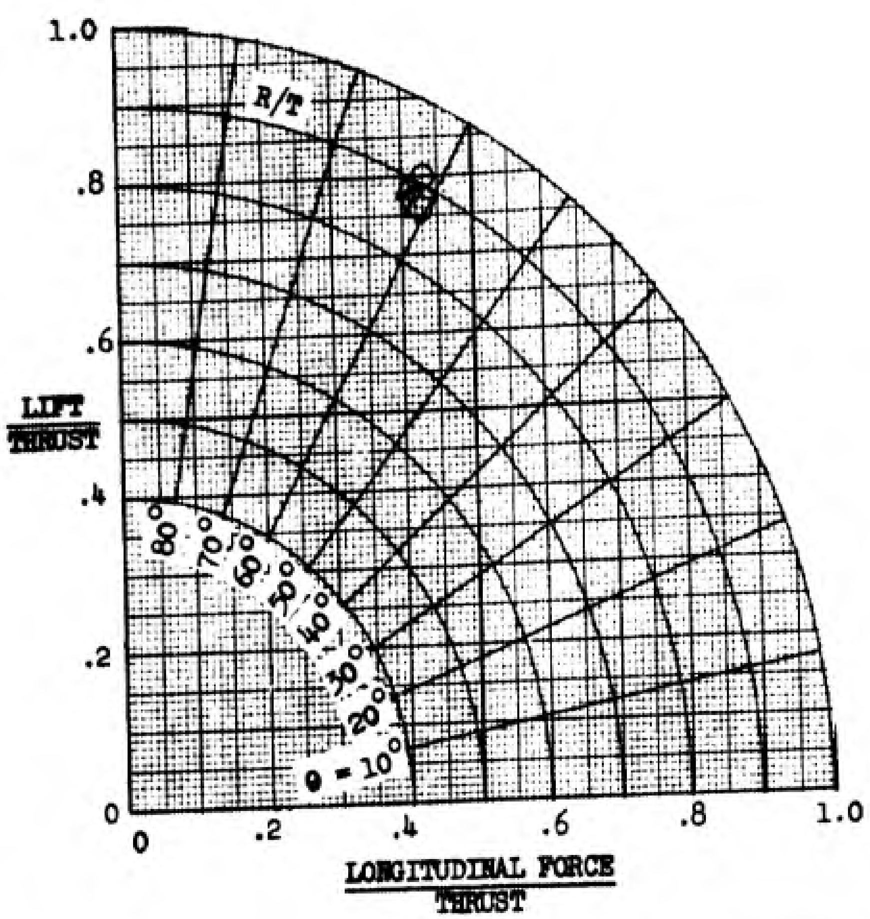
MODEL 88 MONOPLANE CONFIGURATION

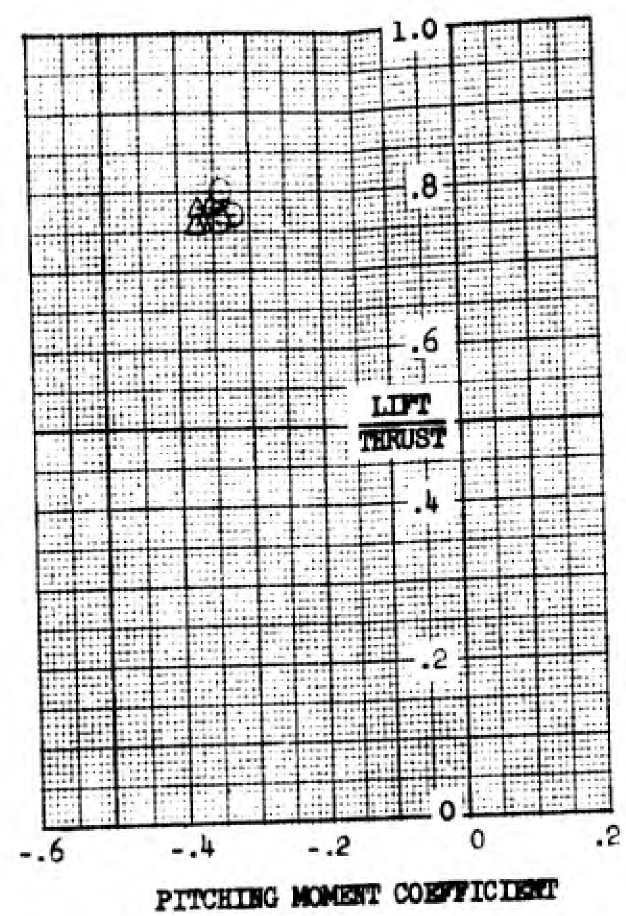
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

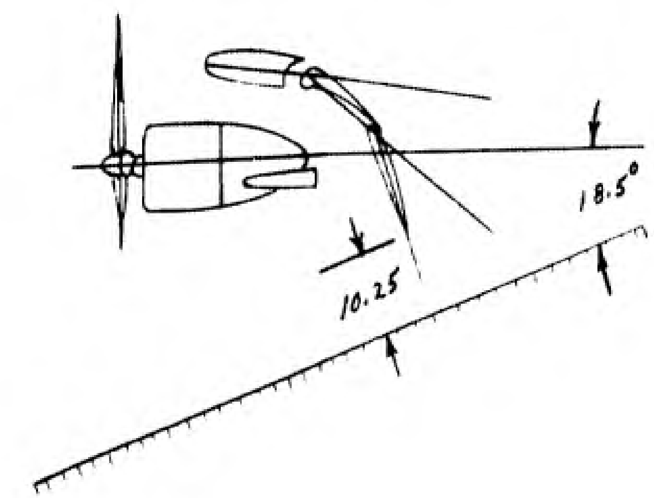
Effect of End Plates With 30° Forward And Aft Flap Deflection, Ground Plane Installed

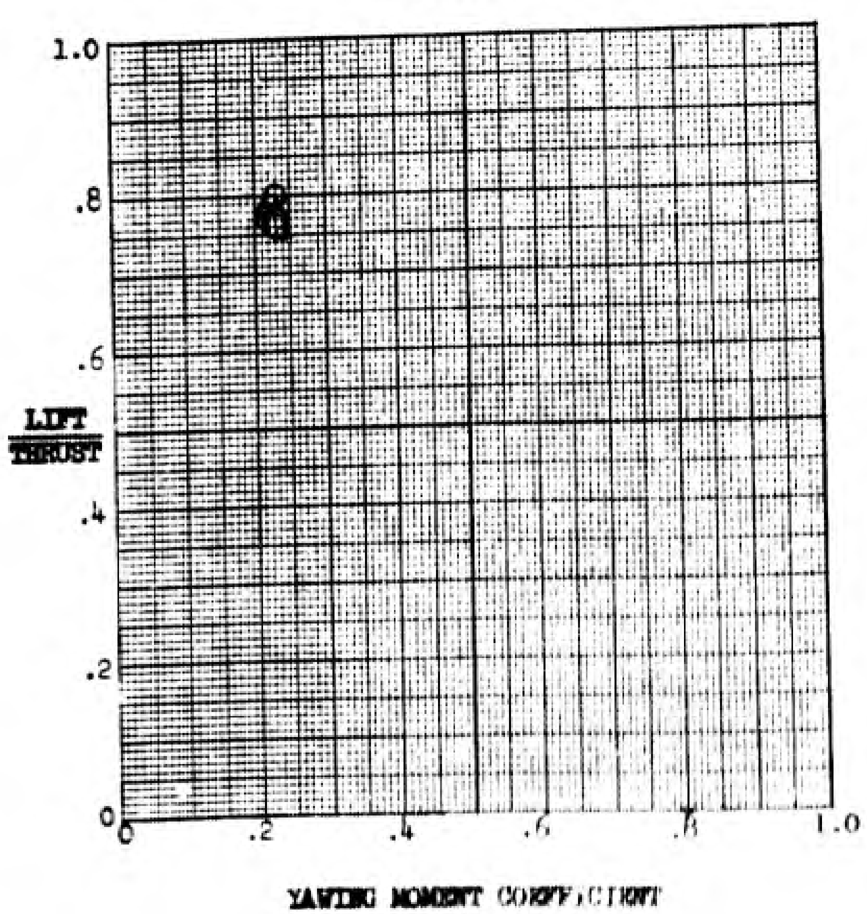
NOTE: Refer to Figure 5 for end plate appearance and location

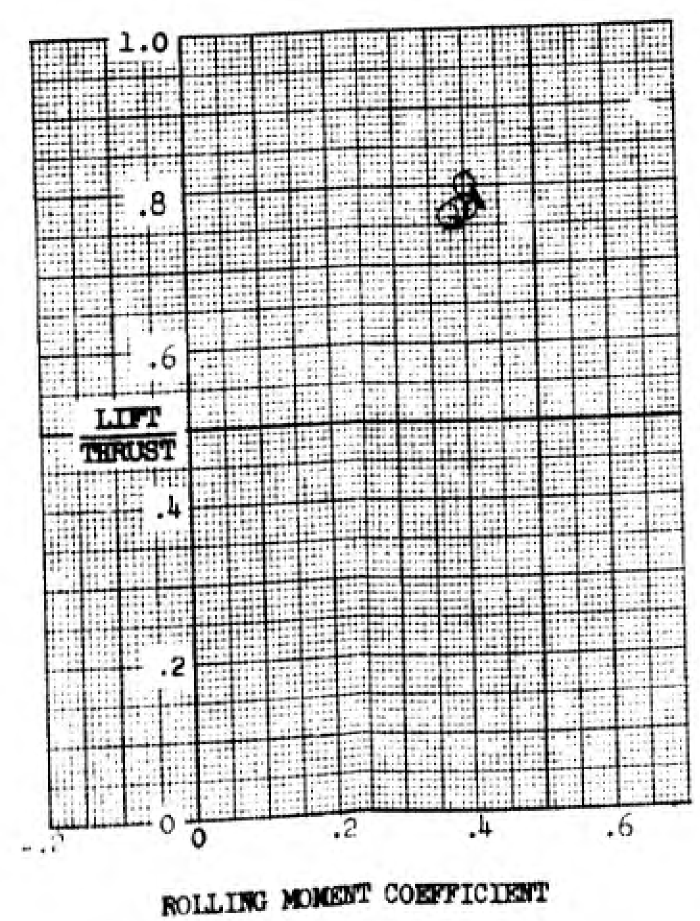
SYM	RUN	PLATES
○	27	OFF
△	30	ON











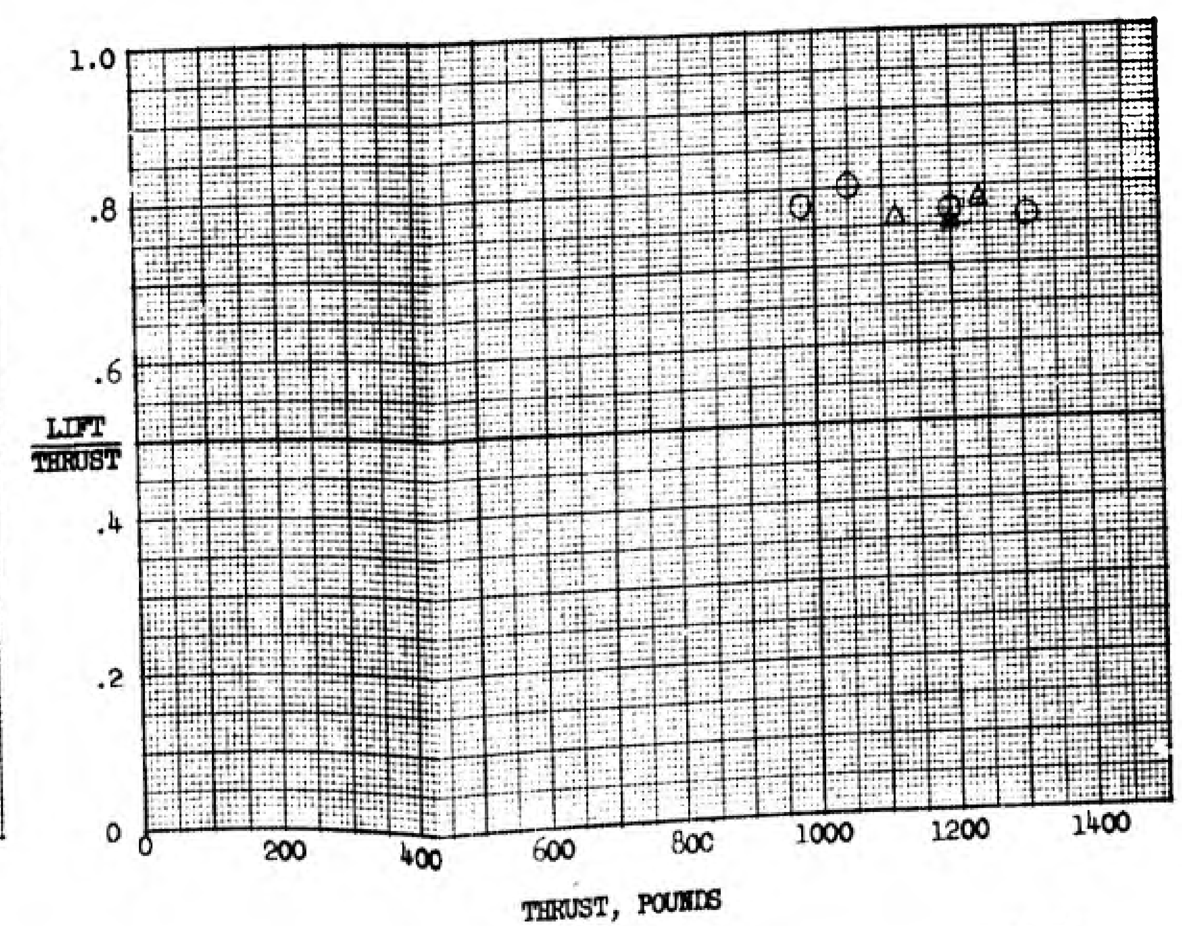


Figure 40

MODEL 88 MONOPLANE CONFIGURATION

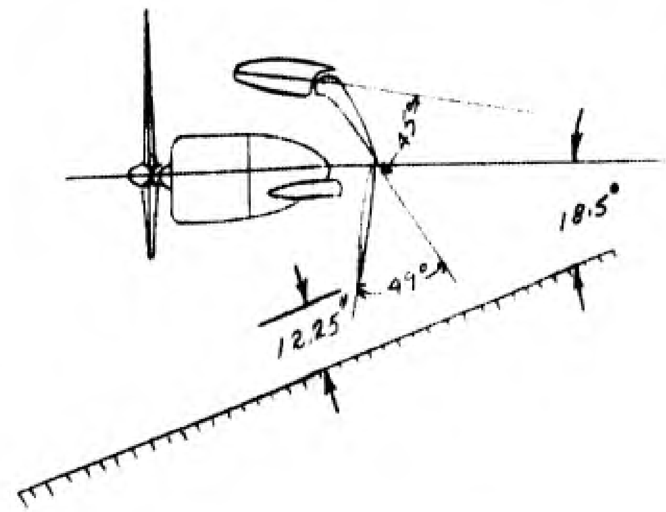
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

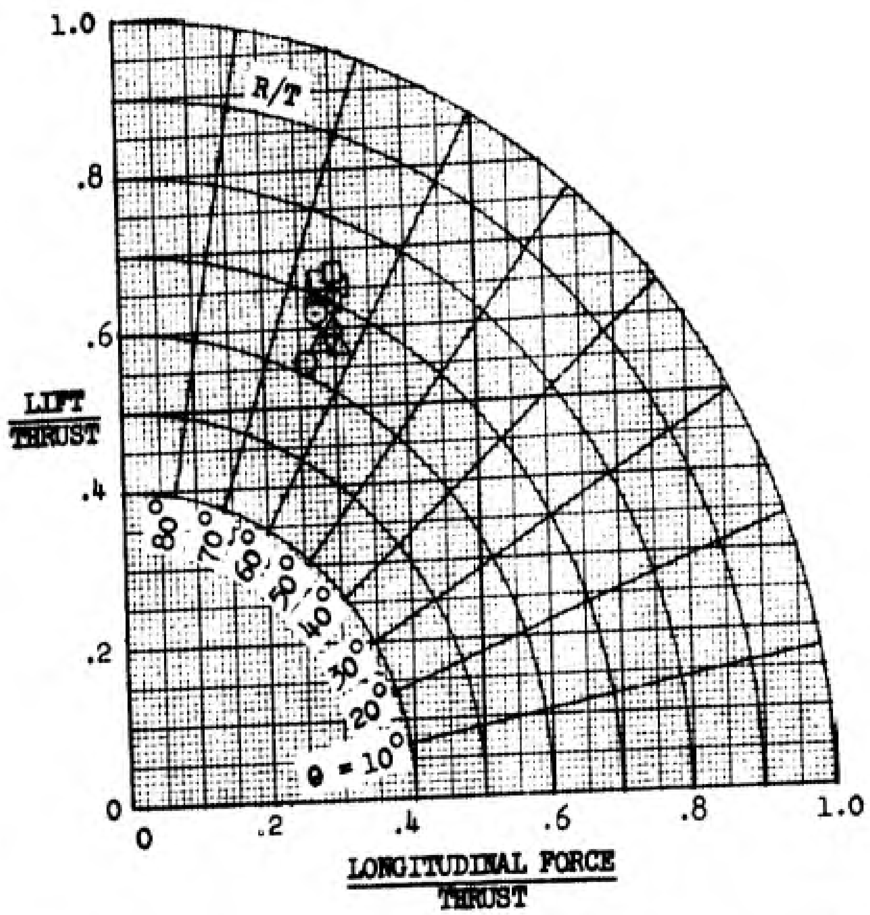
Effect of Ground Plane With 45° Forward Flap Deflection

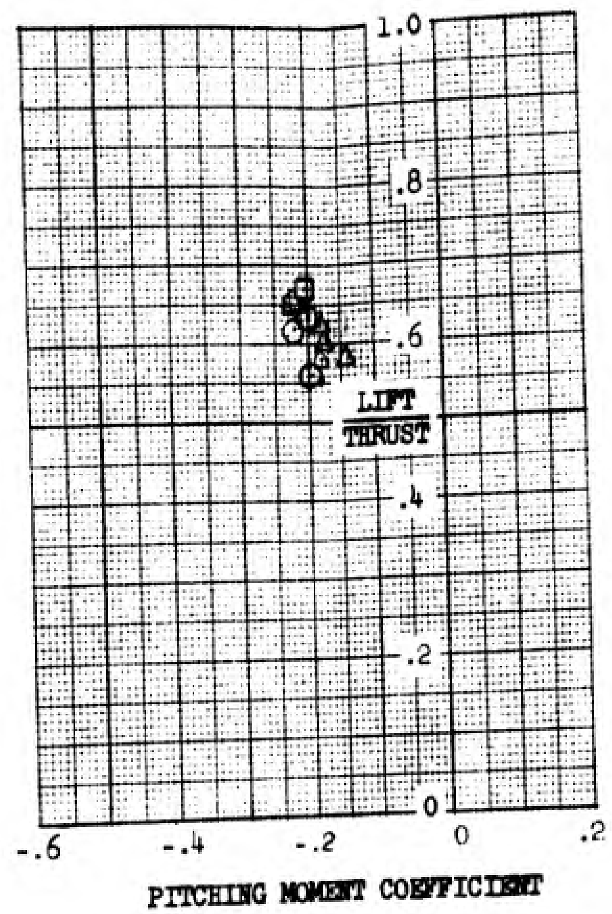
And 49° Aft Flap Deflection With End Plate on Left Side Only

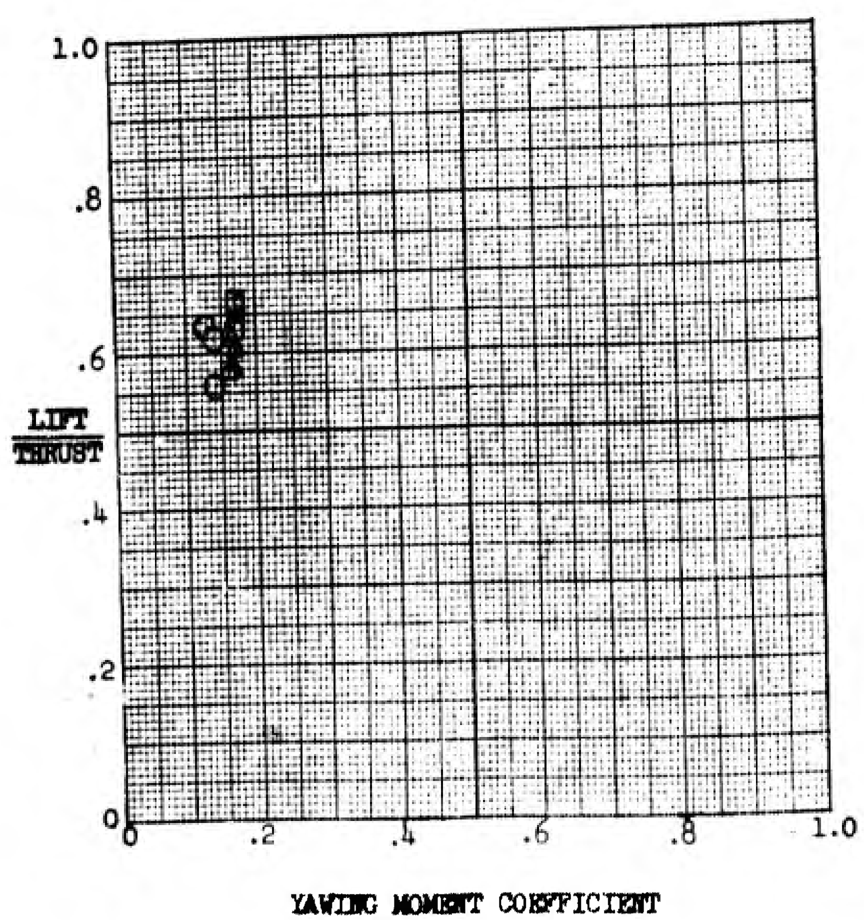
NOTE: Refer to Figure 5 for end plate appearance and location.

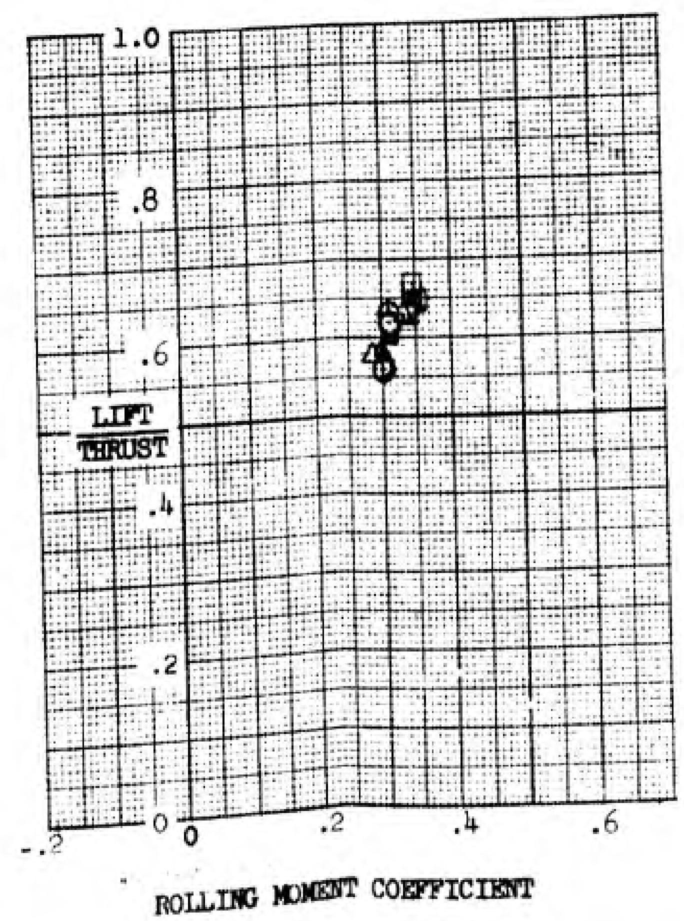
SYM	RUN	PLANE
○	8	OUT
△	8.1	OUT
□	15	IN

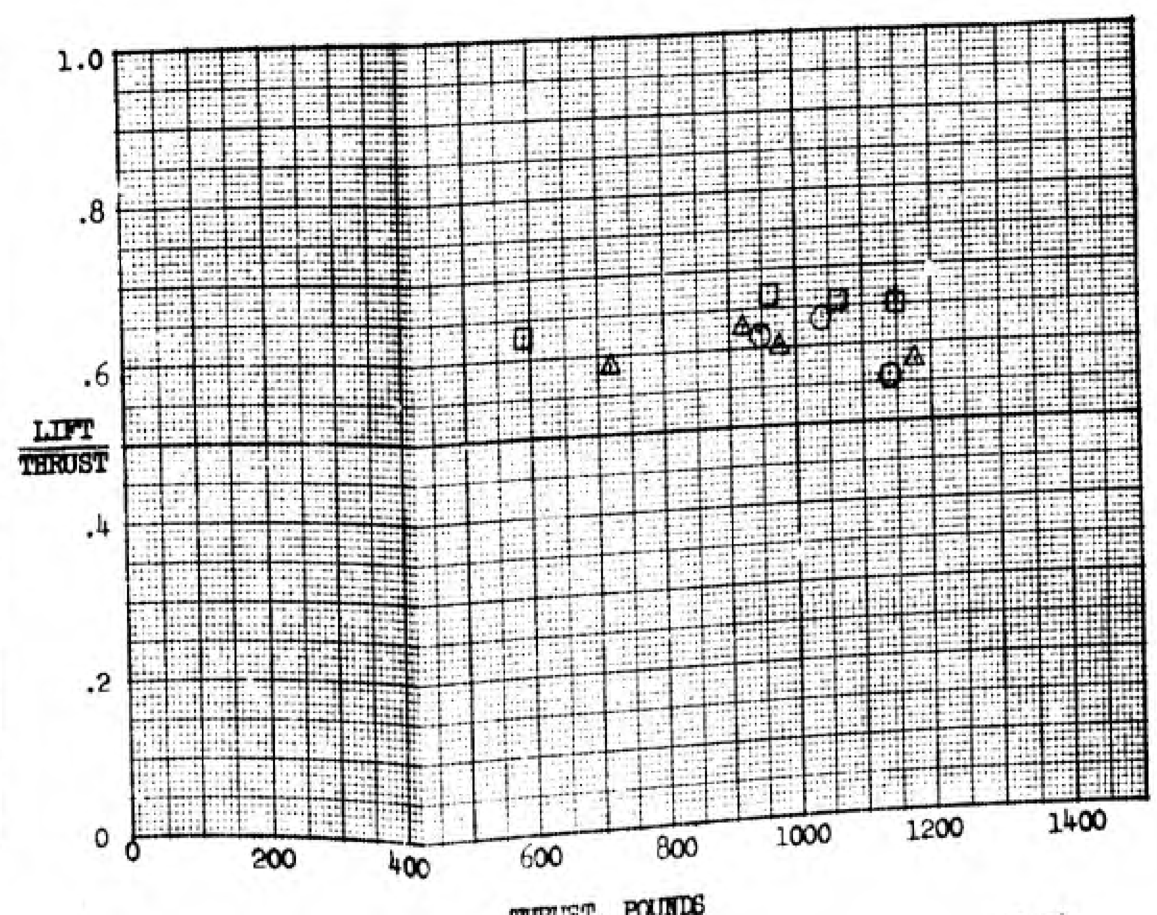












MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

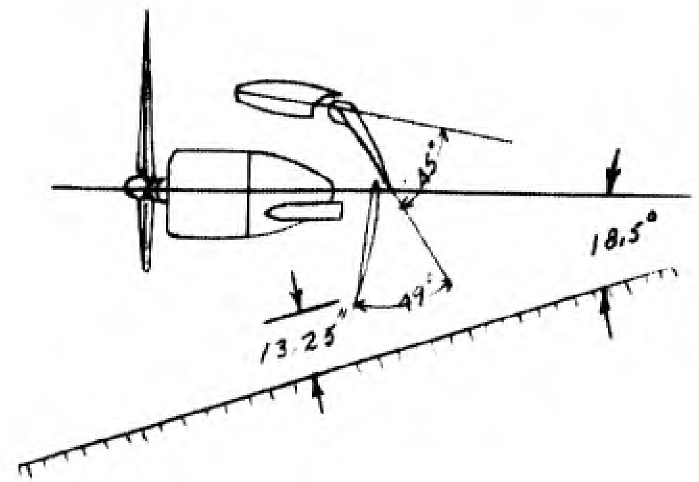
Effect of Ground Plane With 45° Forward Flap Deflection

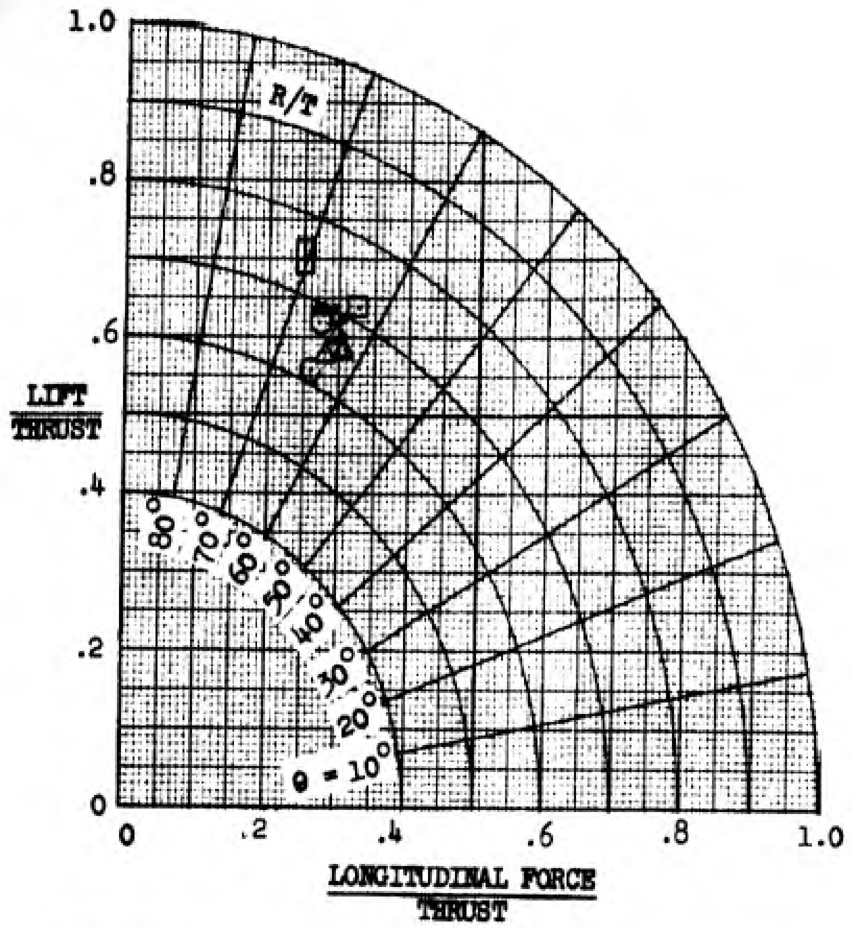
And 49° Aft Flap Deflection With End Plate on Right Side Only

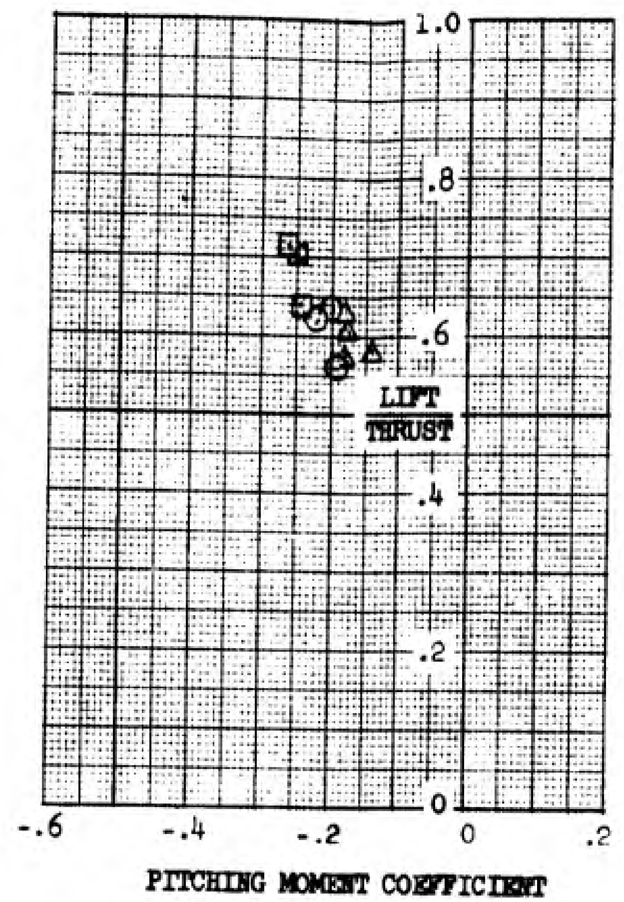
Figure 41

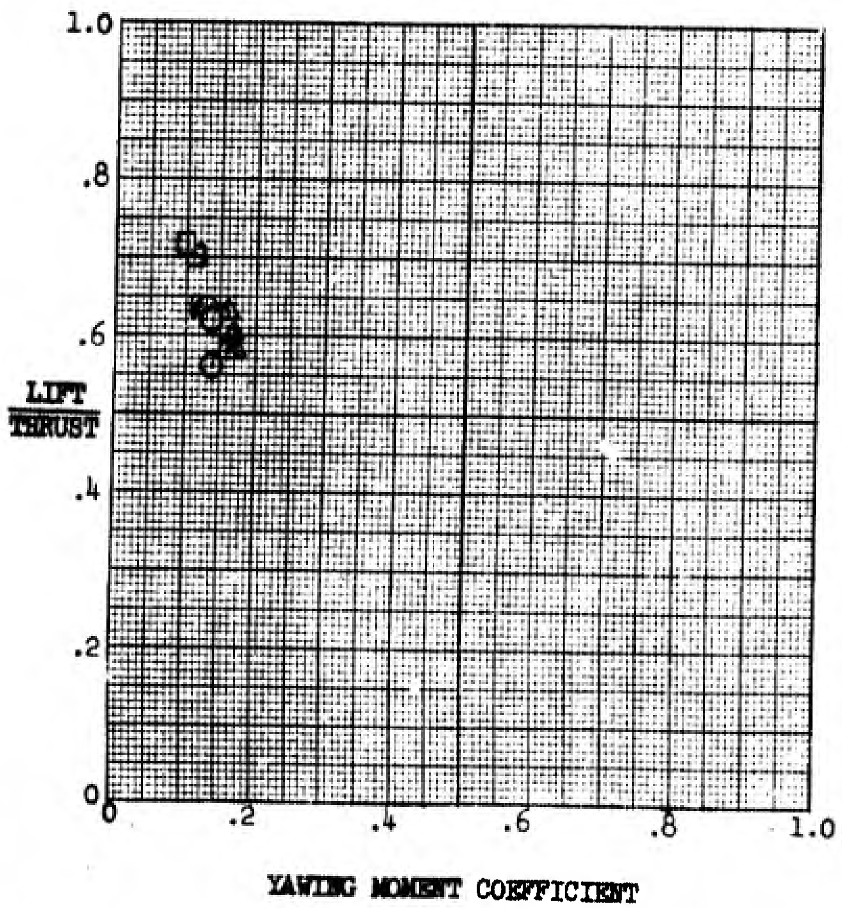
NOTE: Refer to Figure 5 for end plate appearance and location.

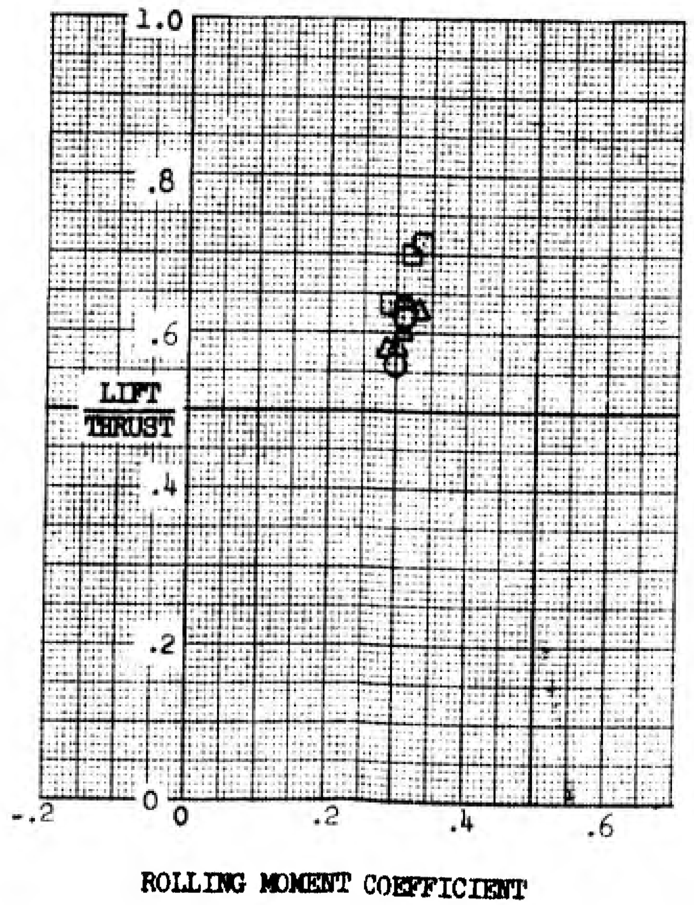
SYM	RUN	PLANE
○	8	OUT
△	8.1	OUT
□	14	IN











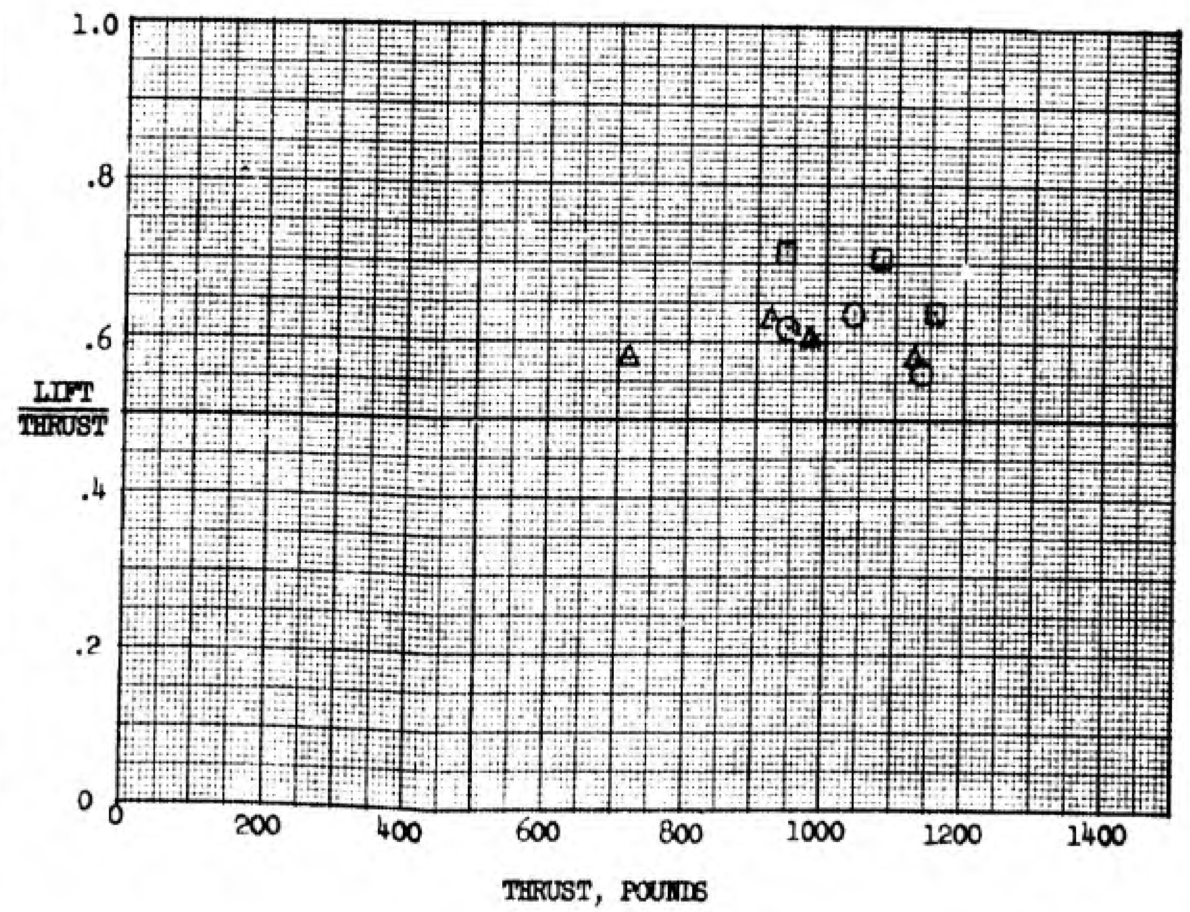


Figure 42

MODEL 88 MONOPLANE CONFIGURATION

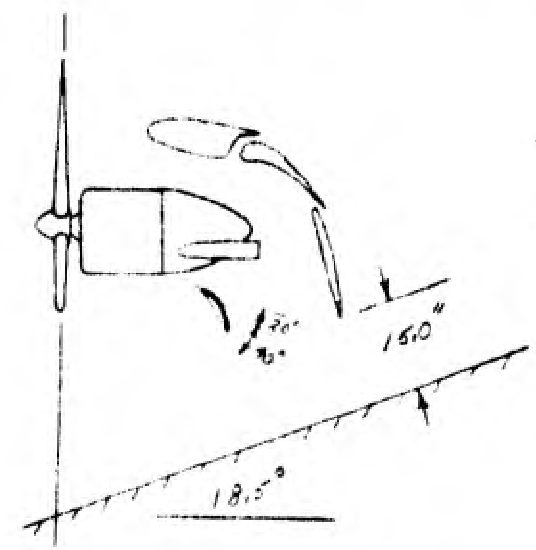
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

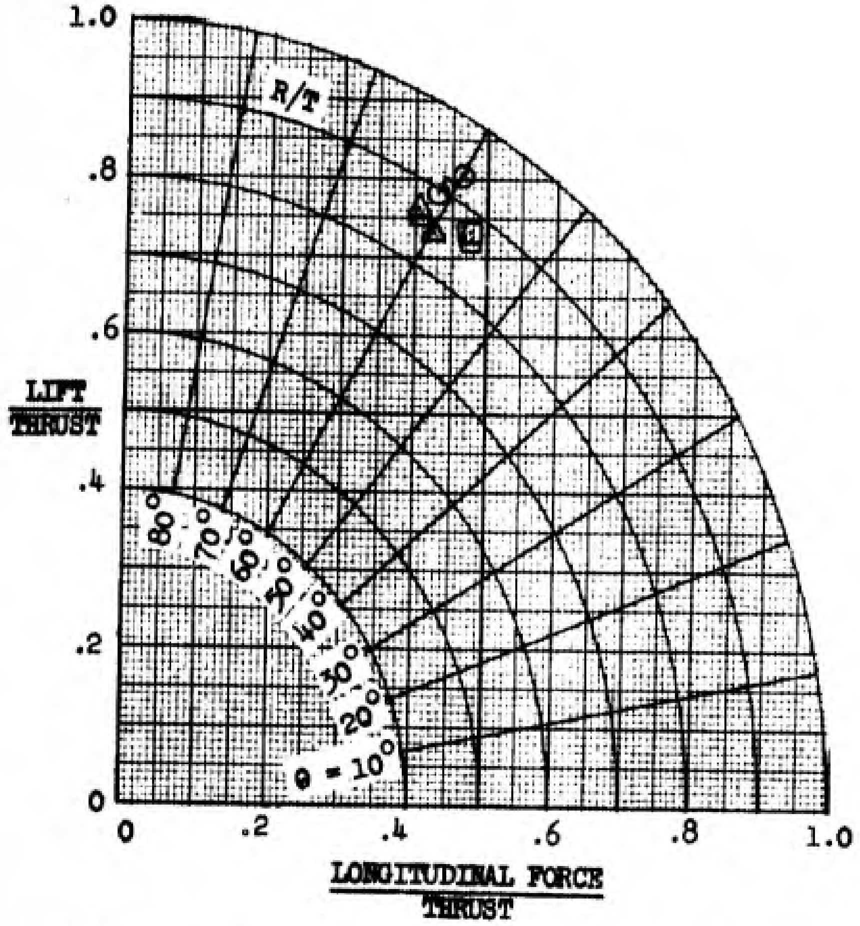
Effect of Deflection Angle of Auxiliary Vane

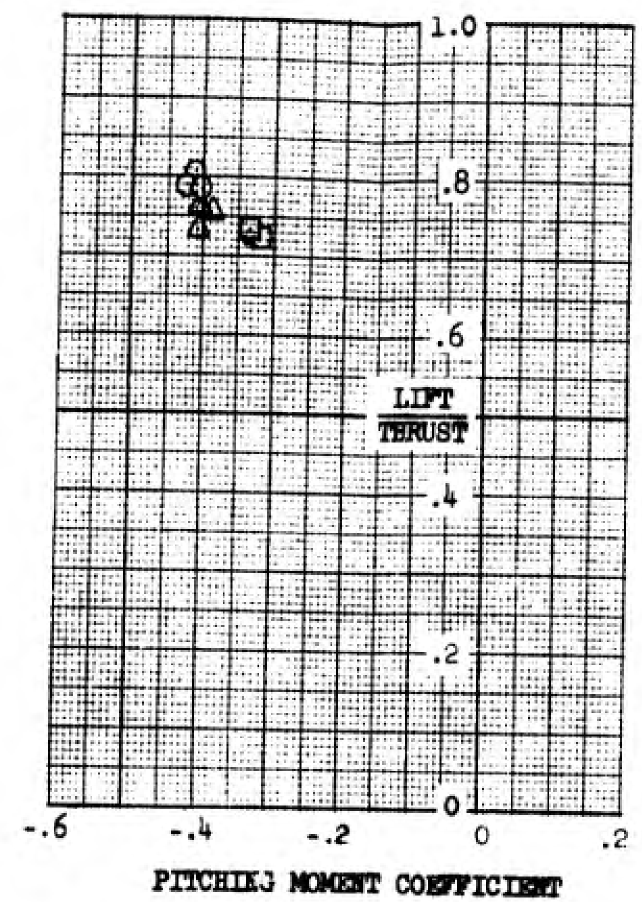
With 30° Forward and Aft Flap Deflection, Ground Plane Installed

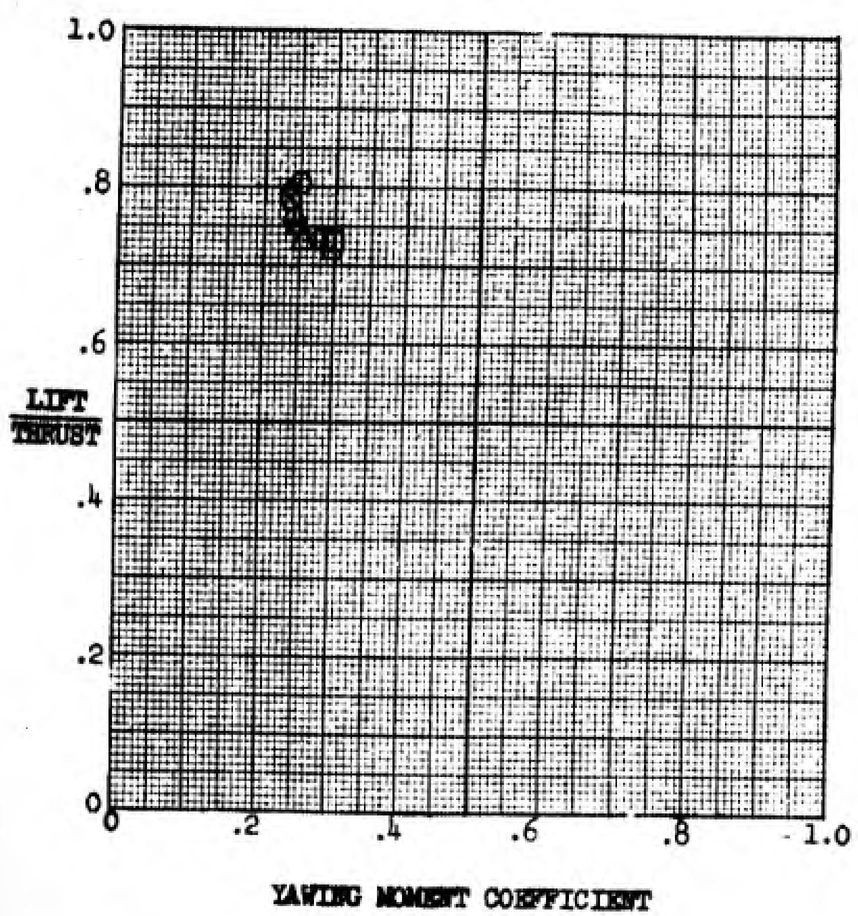
NOTE: Refer to Sketch 1 of Figure 17 for vane appearance and location.

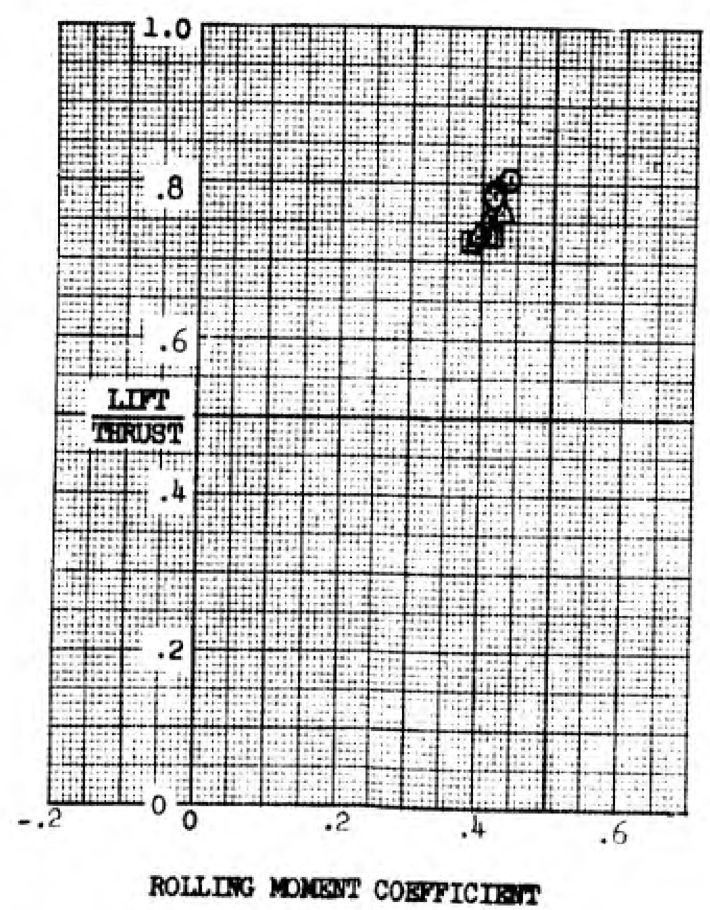
SYM	RUN	VANE ANGLE
○	33	10° Forward
△	34	40° Forward
□	35	20° Aft











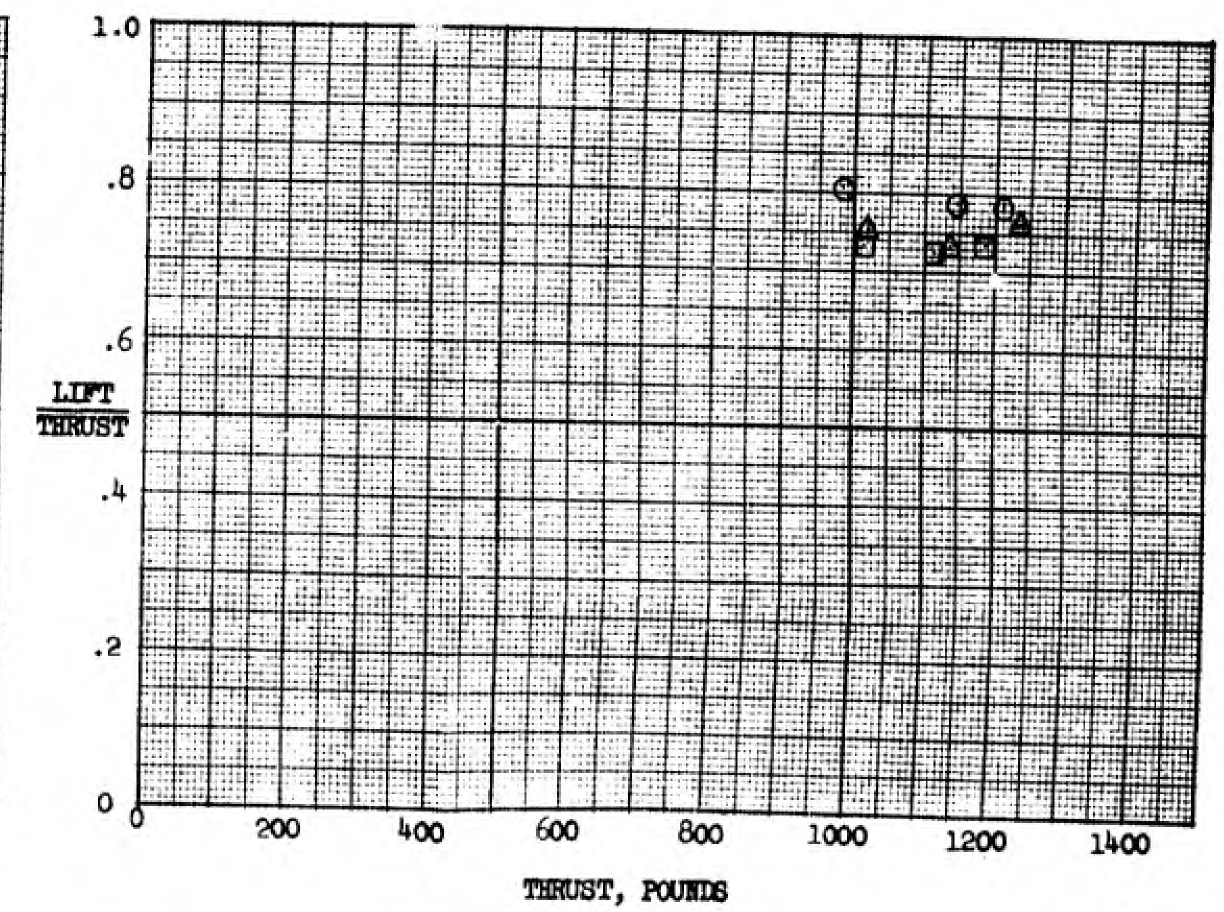


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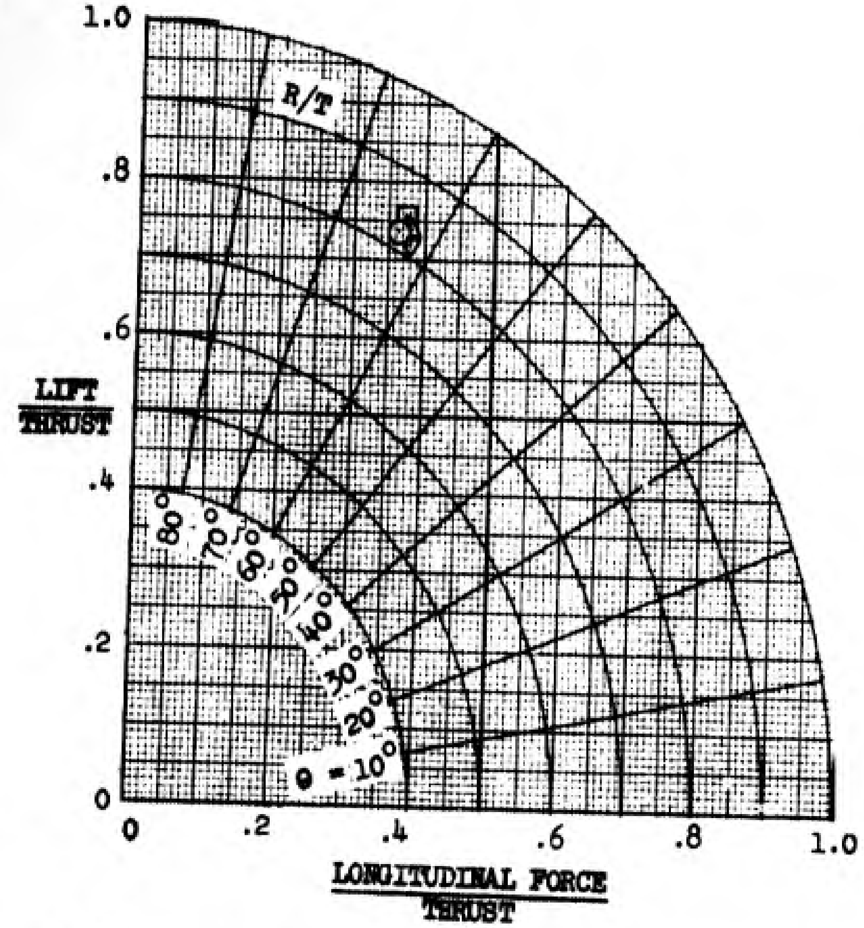
Figure 43

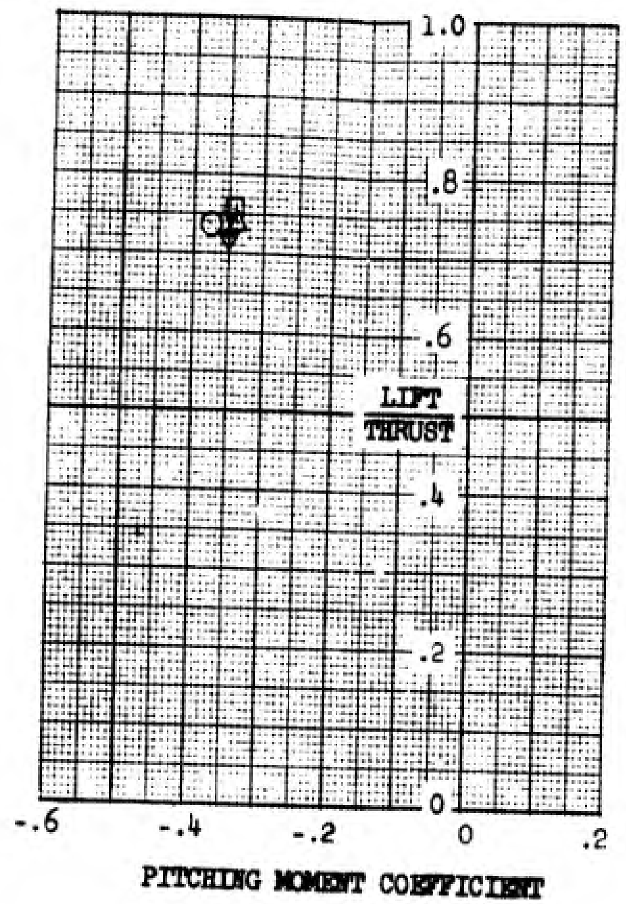
MODEL 88 MONOPLANE CONFIGURATION

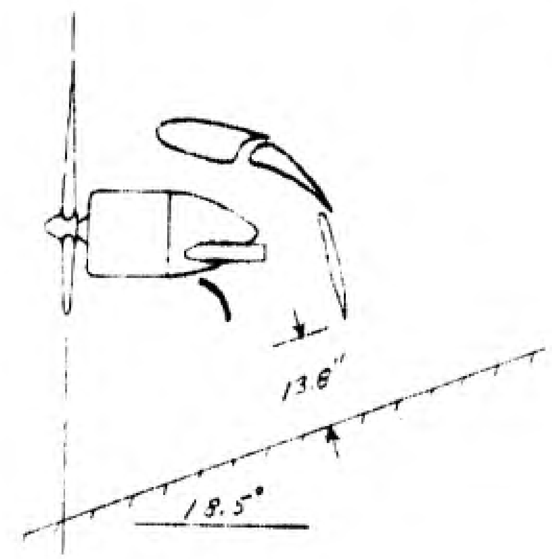
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

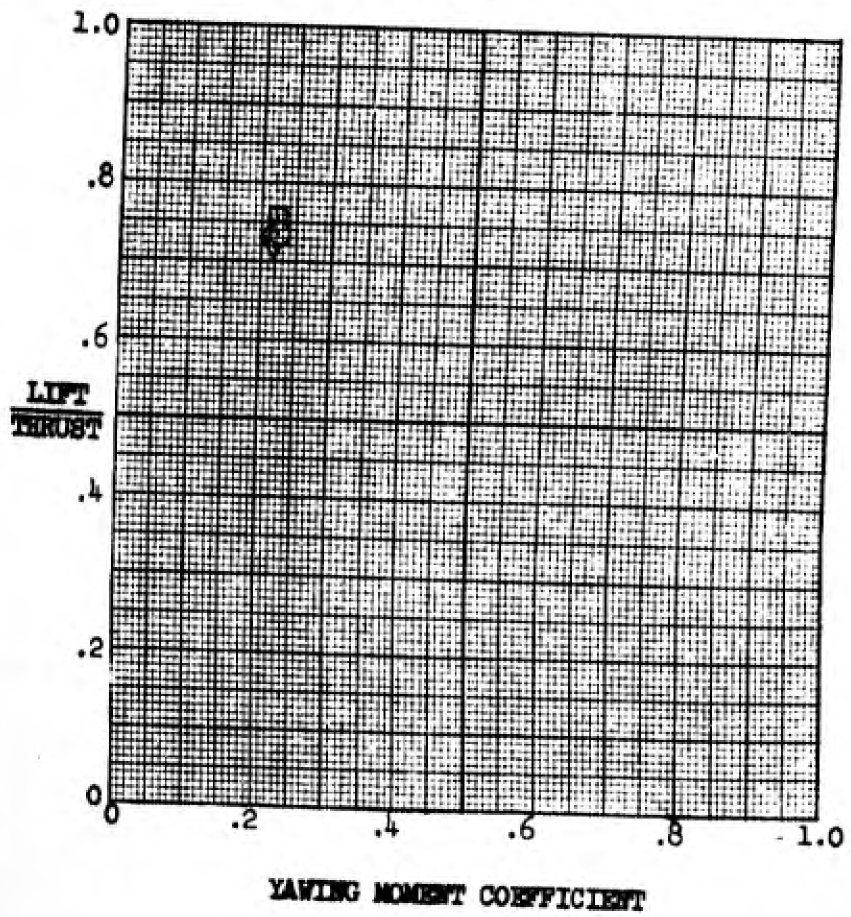
Results with Auxiliary Vane Mounted Below the Wing (Sketch 2 of Figure 17)
With the Wing at 8.75° Angle of Incidence and Forward and Aft Flaps At
35° Deflection, Ground Plane Installed

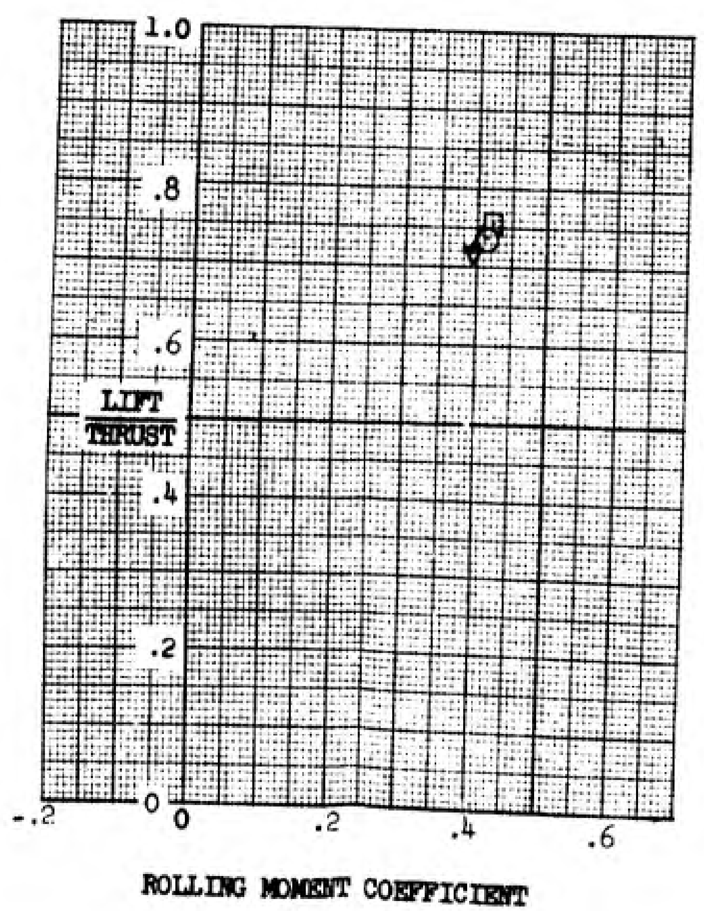
Run No. 36











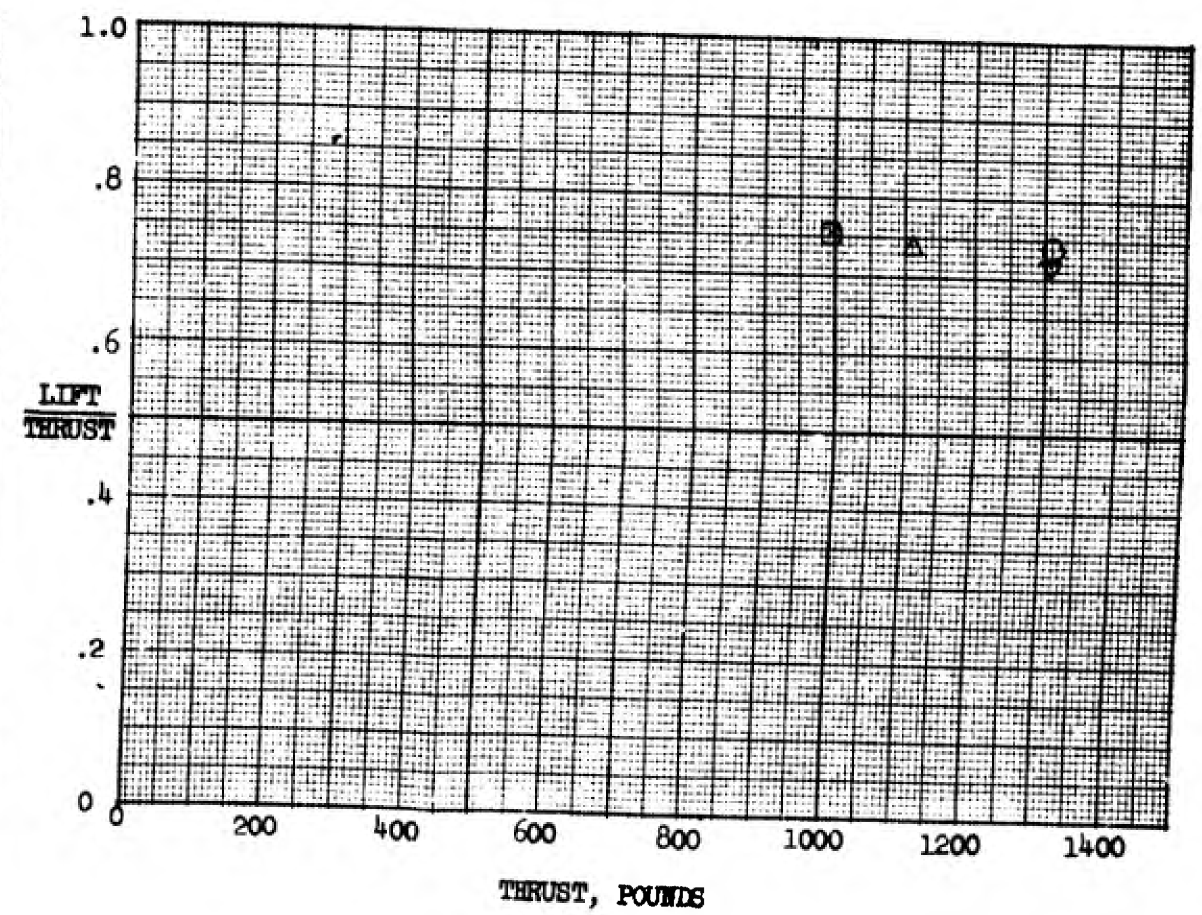


Figure 44

MODEL 88 MONOPLANE CONFIGURATION

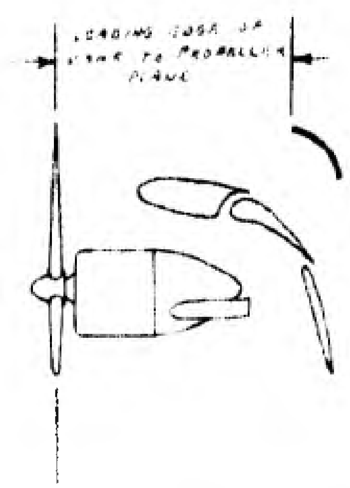
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

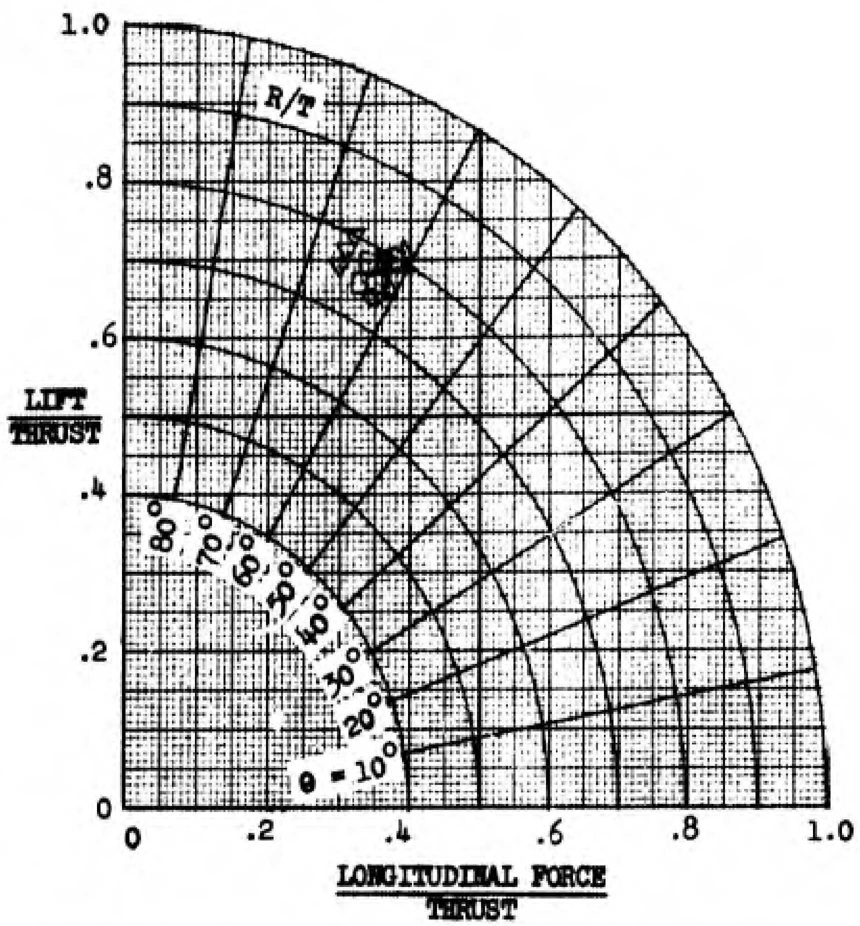
Results with Auxiliary Vane Mounted Above the Wing

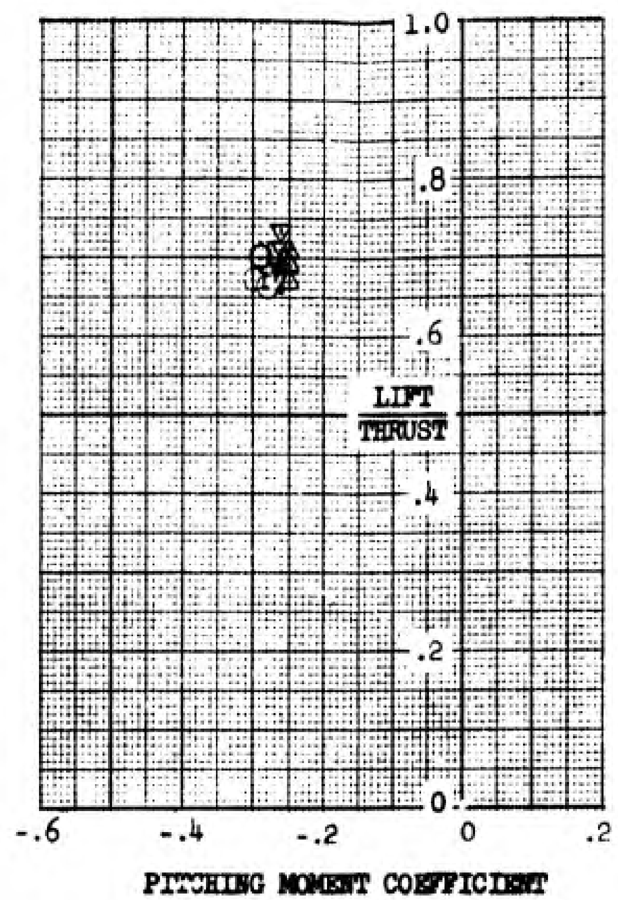
In Several Horizontal and Vertical Positions (Sketch 3 of Figure 17)

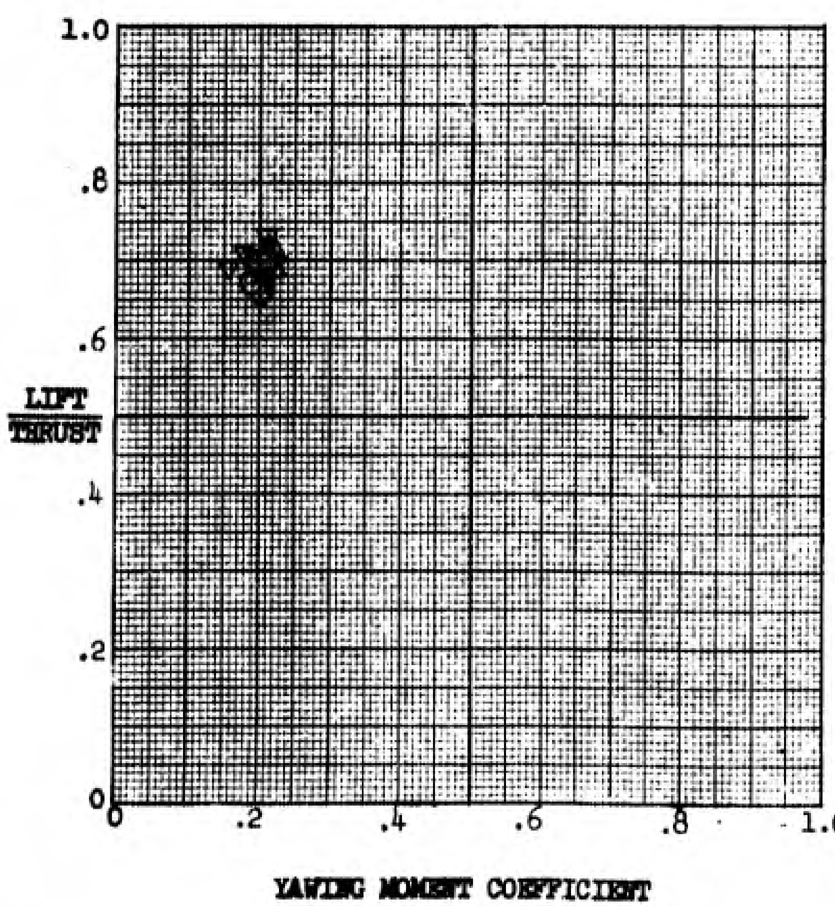
NOTE: Ground plane not installed.

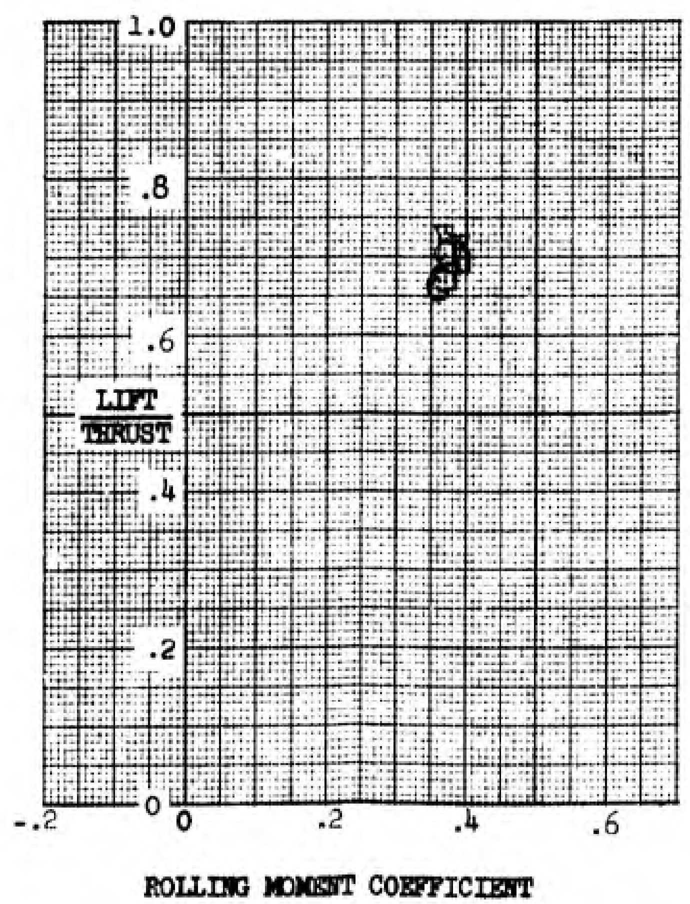
SYM	RUN	DISTANCE FROM LEADING EDGE OF VANE TO PROPELLER PLANE
○	47	42.0"
△	48	52.2"
□	49	36.0"
▽	50	35.8"











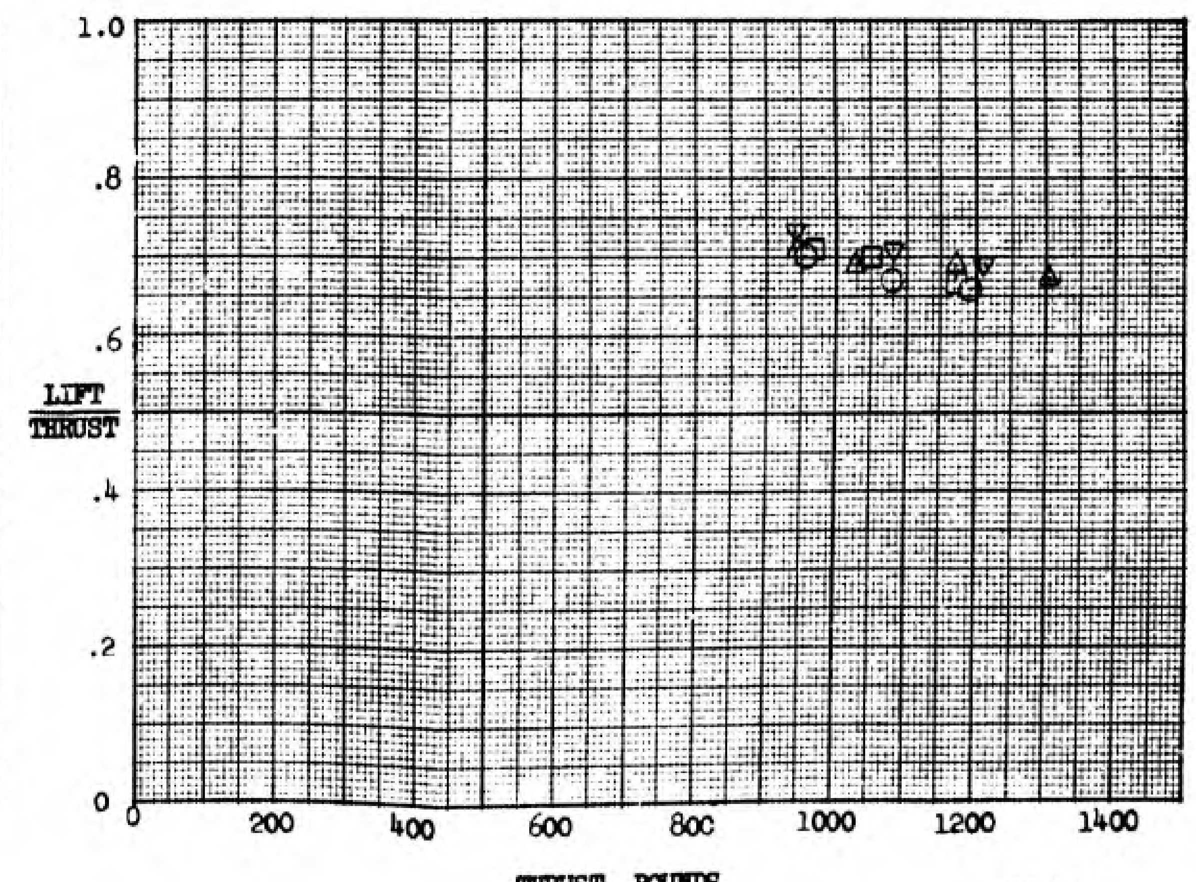


Figure 45

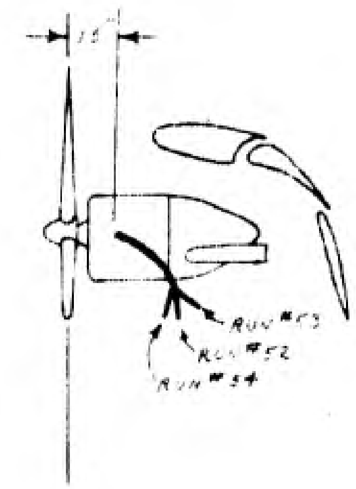
MODEL 88 MONOPLANE CONFIGURATION

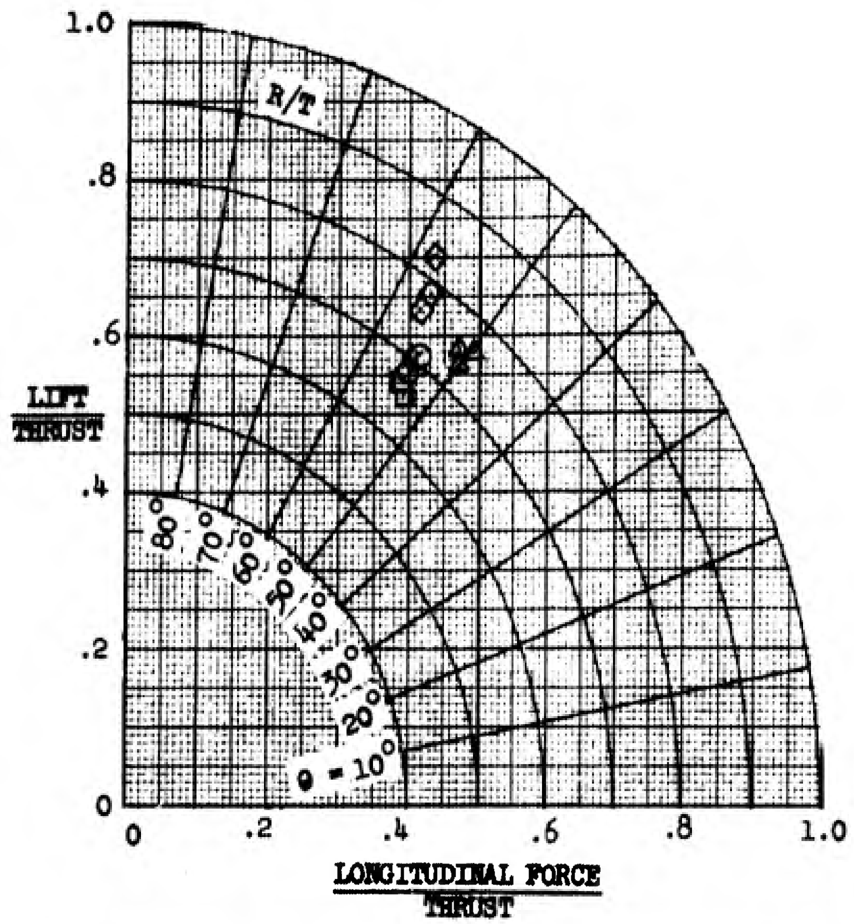
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

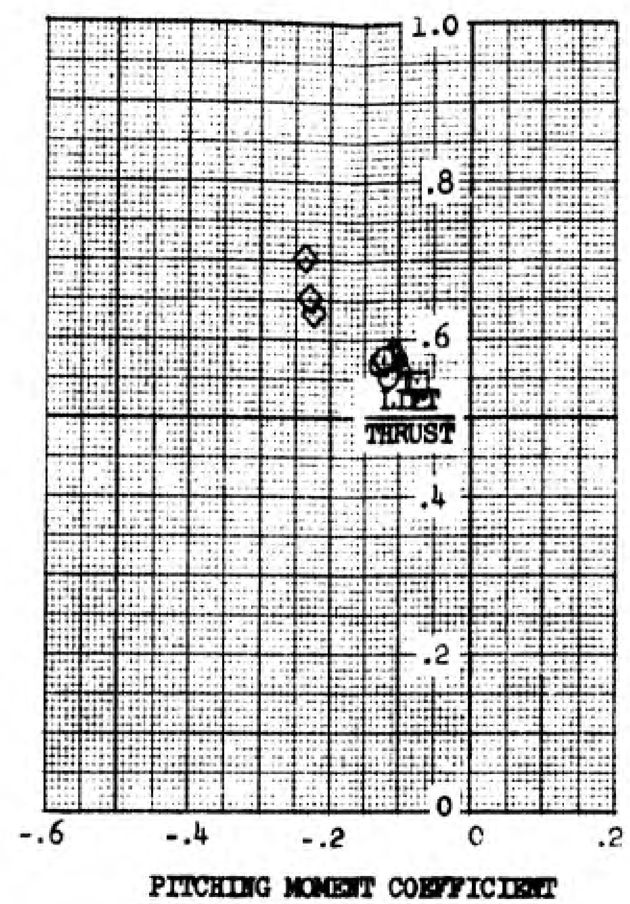
Effect of Auxiliary Vane Deflection (Sketch 4 of Figure 17) With Wing at 13° Angle of Incidence and Forward and Aft Flaps at 35° Deflection,

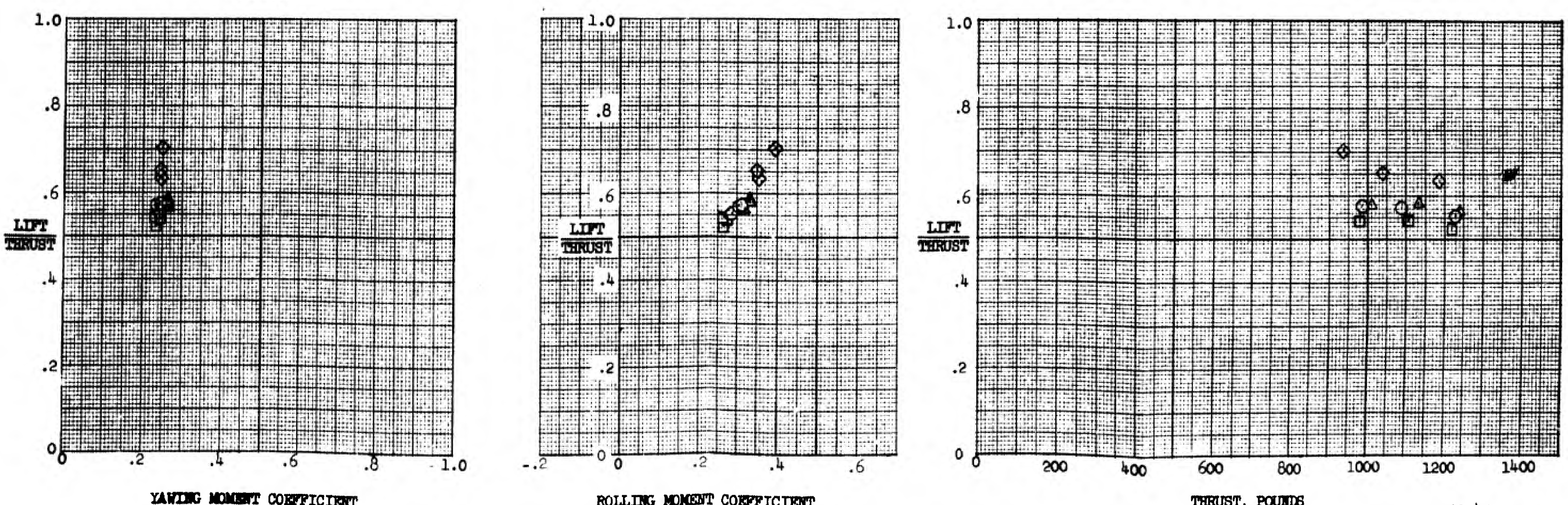
Ground Plane Removed

SYMBOL	RUN	VANE ANGLE
◇	51	No Vane
○	52	12
△	53	42
□	54	-5









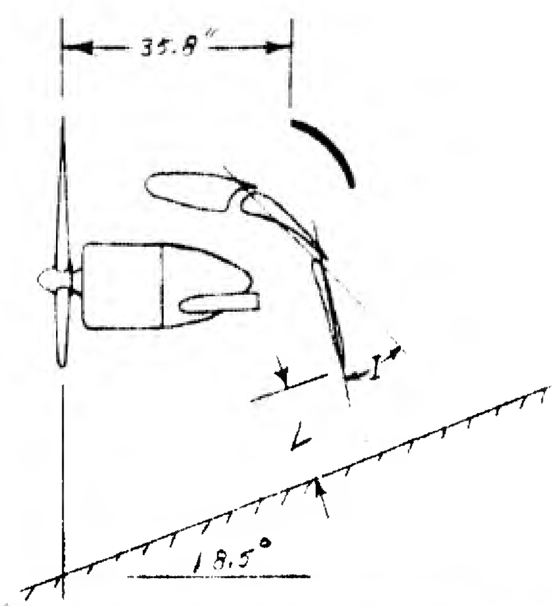
MODEL 88 MONOPLANE CONFIGURATION

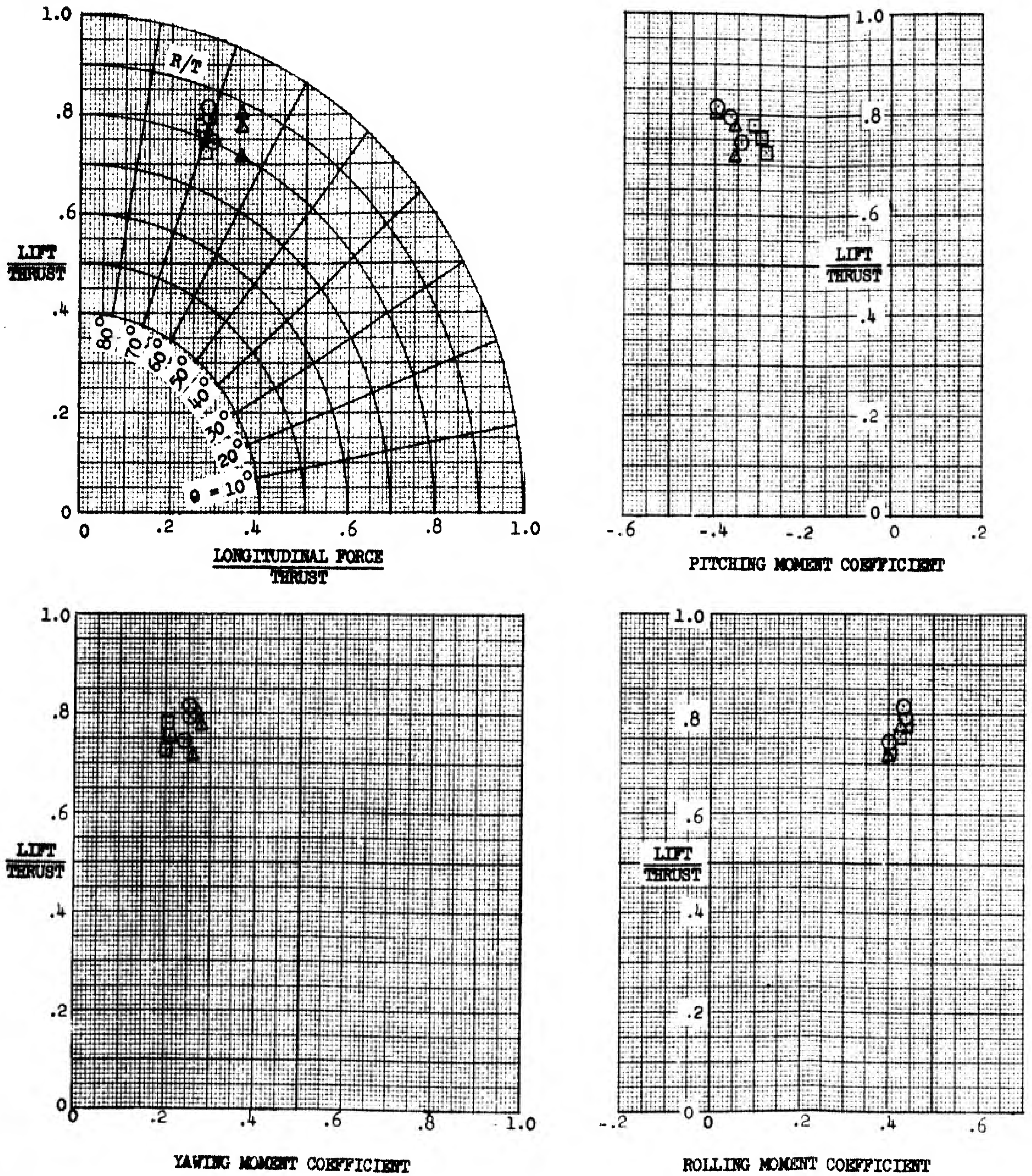
Figure 46

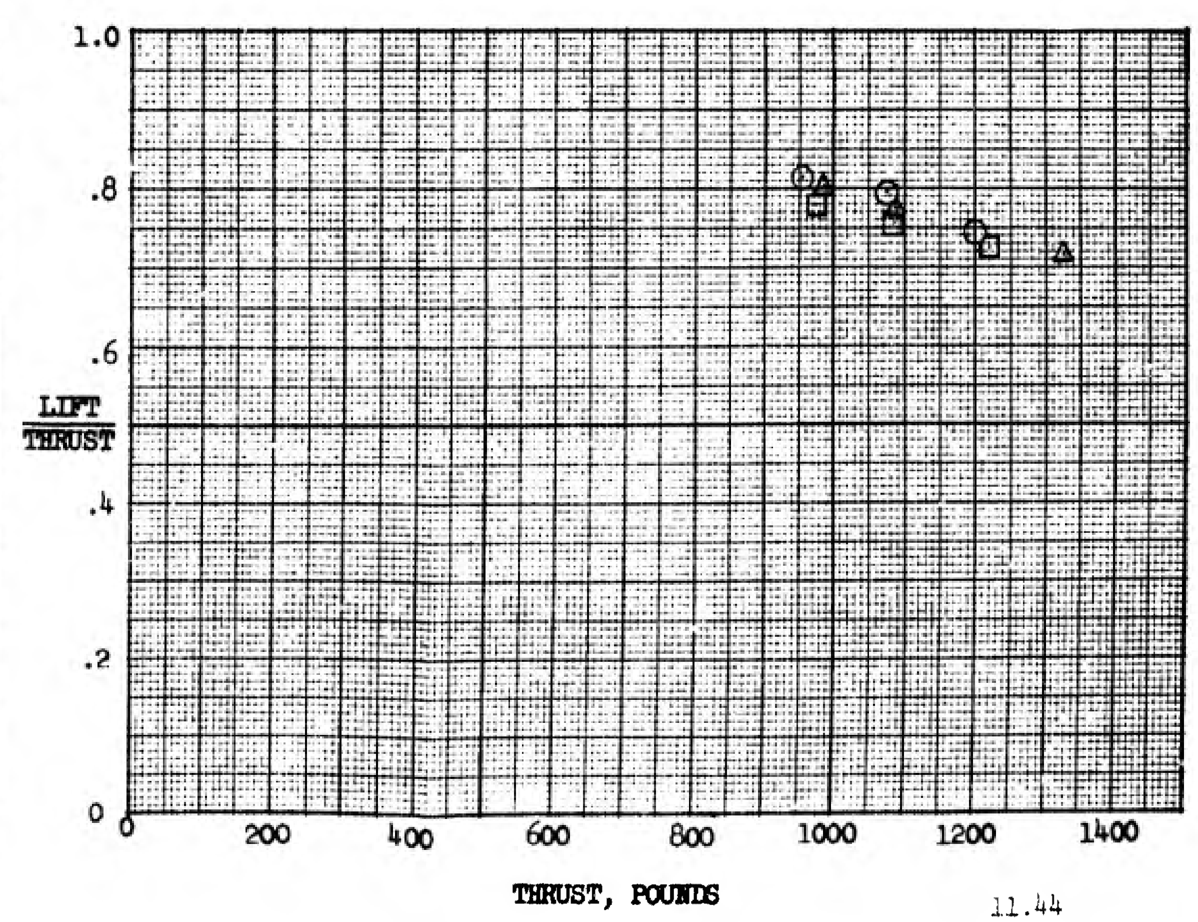
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Results with Auxiliary Vane Mounted Above the Wing (Sketch 5 of Figure 17)
With the Wing at 13° Angle of Incidence and Forward Flap at 30° Deflection,
Ground Plane Installed

SYMBOL	RUN	I
○	60	30
△	61	20
□	62	35







11.44

Figure 47

MODEL 88 MONOPLANE CONFIGURATION

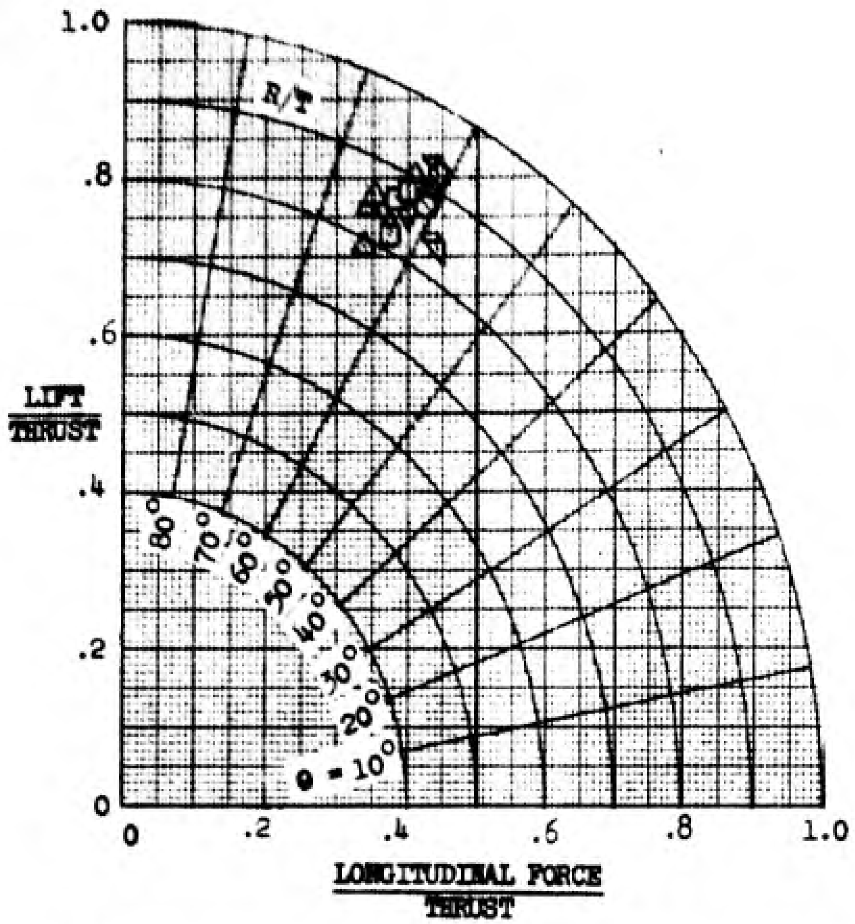
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

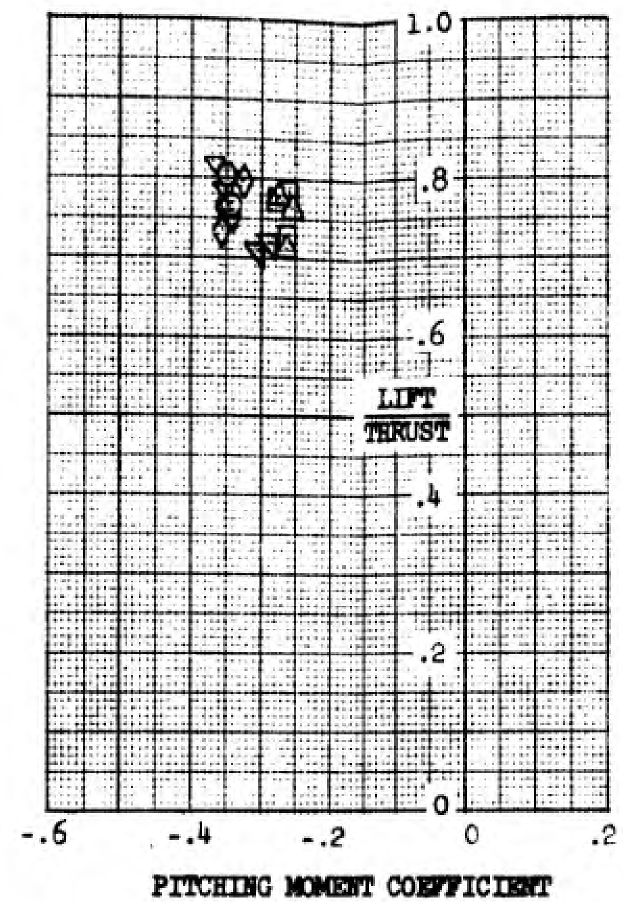
Effect of Auxiliary Vane Mounted Ahead of the Wing

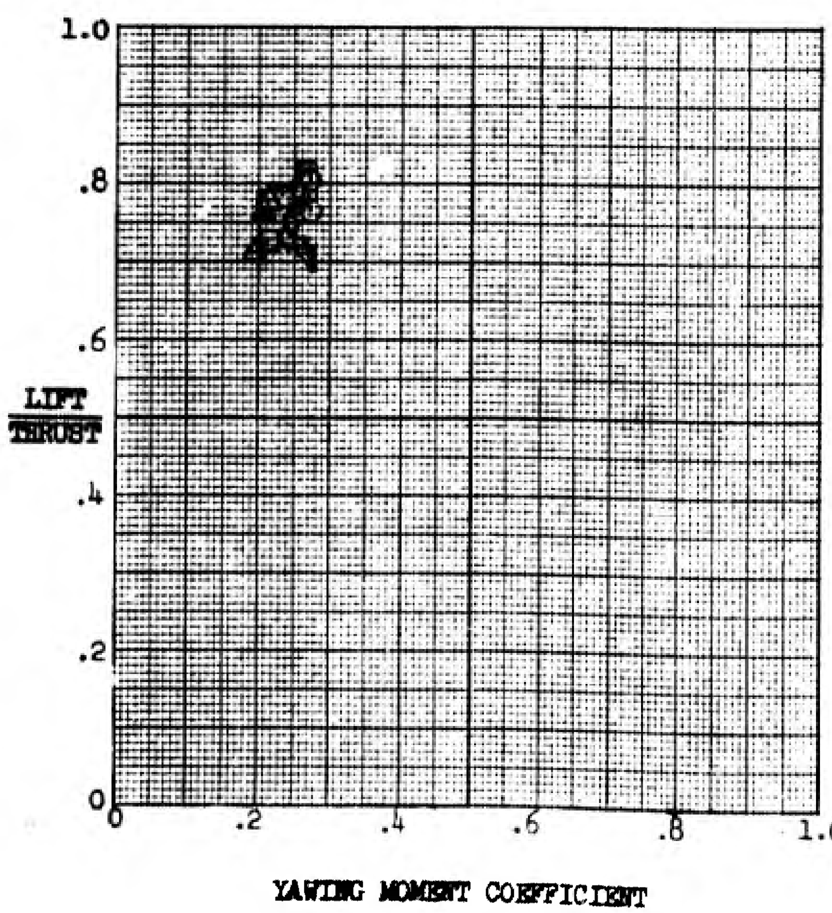
(Sketches 6, 7, 8, 9 and 10 of Figure 17)

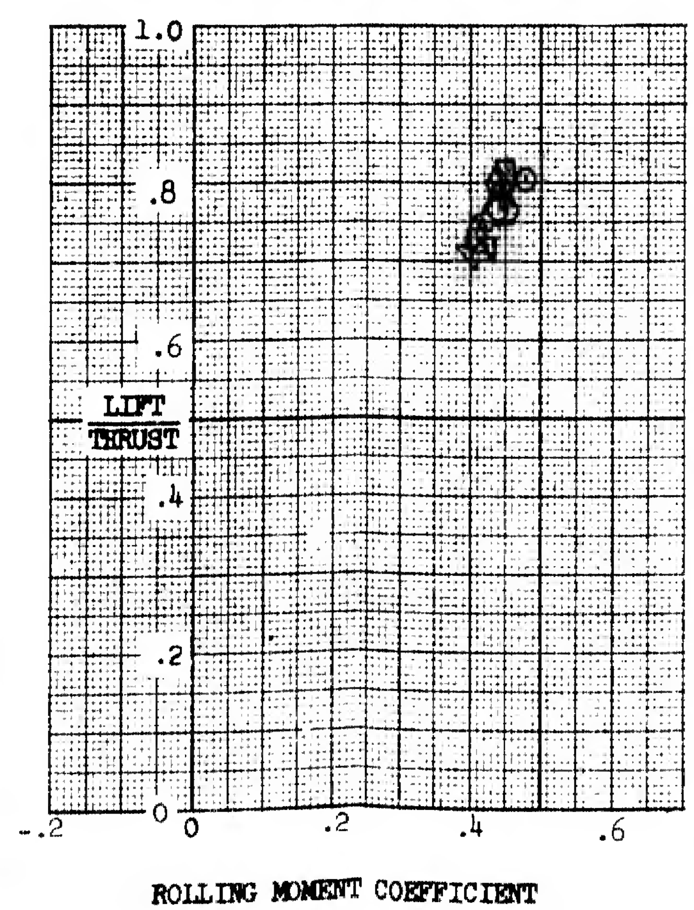
Symbol	Run	Angle of Attack Of Vane	Leading Edge of Vane Above Leading Edge of Wing	Trailing Edge of Vane Above Leading Edge of Wing
○	63	12.5°	14.75"	11.5"
△	64	15.5°	8.0 "	4.0"
□	65	6.0°	7.0"	5.5"
◇	66	0°	6.5 "	6.5"
▽	67	-9.0°	5.5 "	8.0"

NOTE: Refer to sketches 6, 7, 8, 9 and 10 of Figure 17 for details.









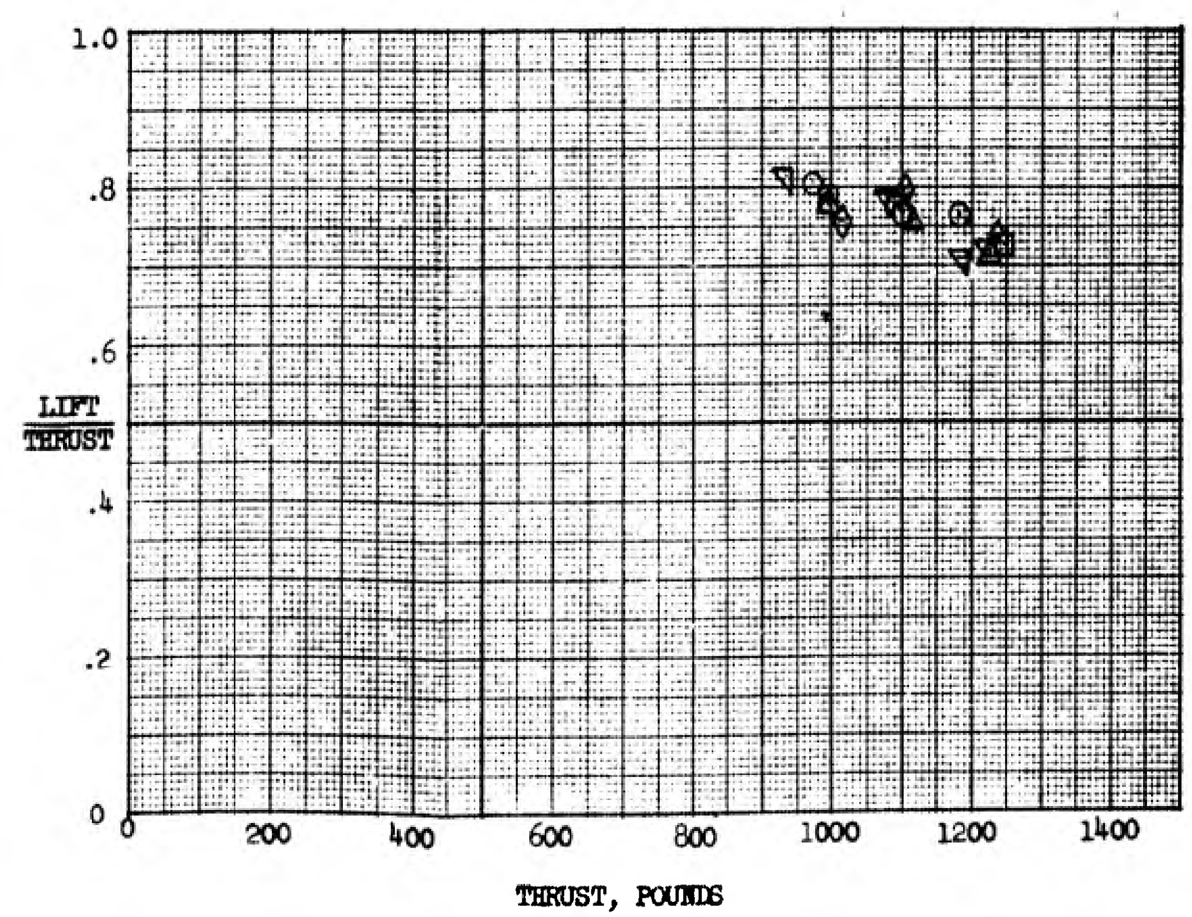


Figure 48

MODEL 88 MONOPLANE CONFIGURATION

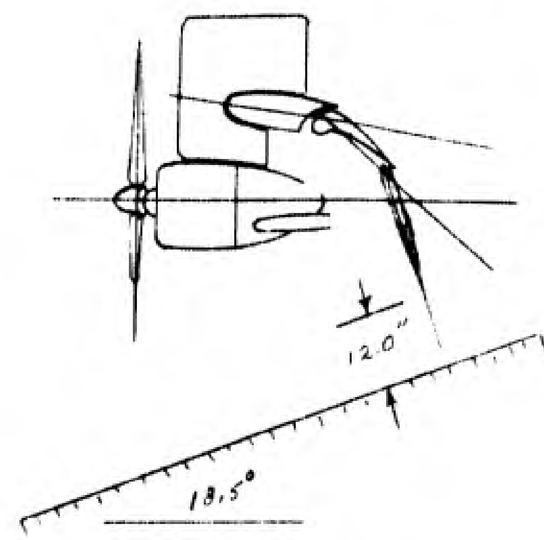
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

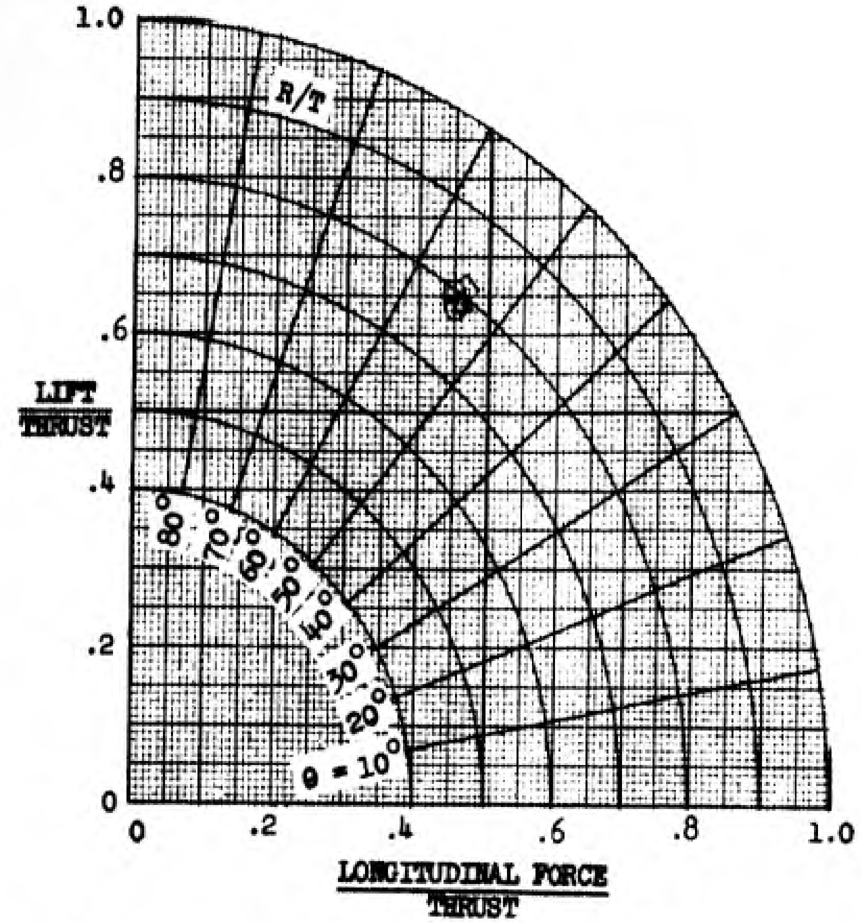
Effect of Vane Mounted Perpendicular to the Wing (Sketch 16 Figure 17)

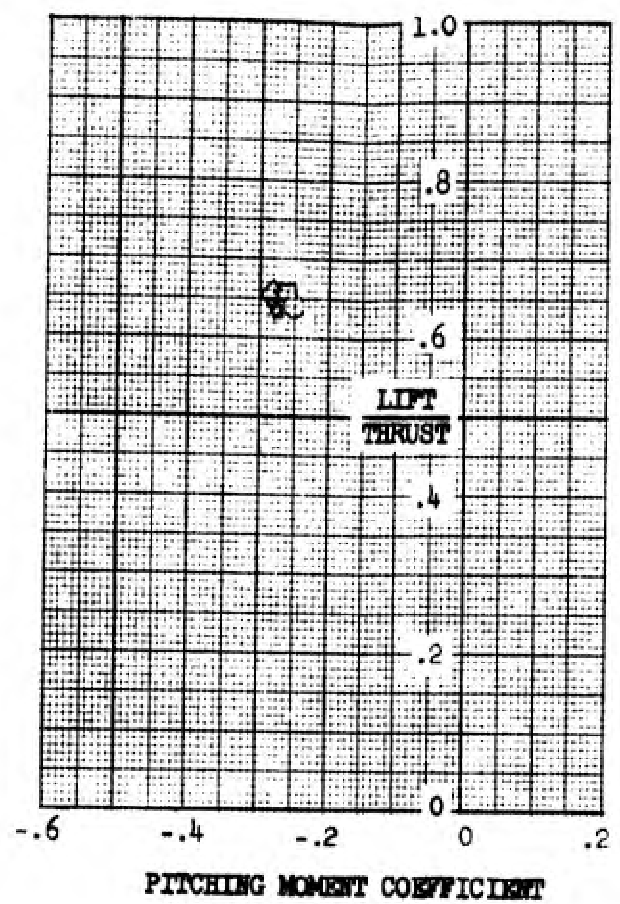
With Wing at 13° Angle of Incidence and Forward and Aft Flaps Deflected 30°

Ground Plane Installed

SYM	RUN	VANE ANGLE
○	76.1	25.0° Right
△	76.2	12.5° Right
□	76.3	Neutral
▽	76.4	12.5° Left
◇	76.5	25.0° Left







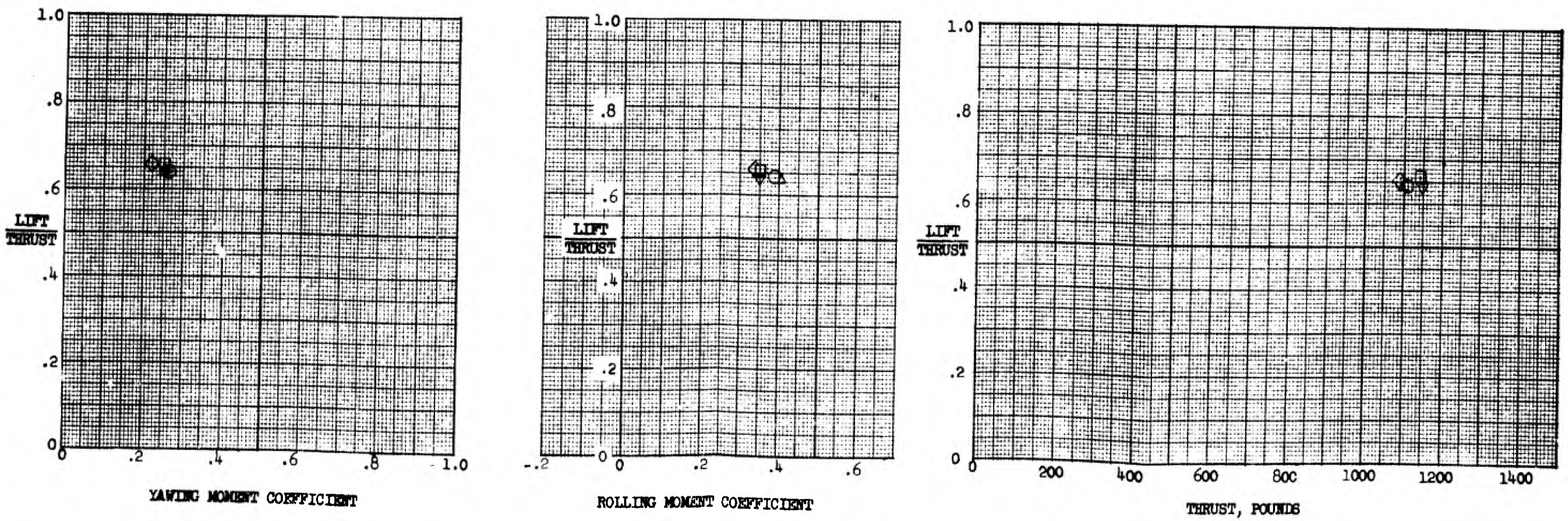


Figure 49

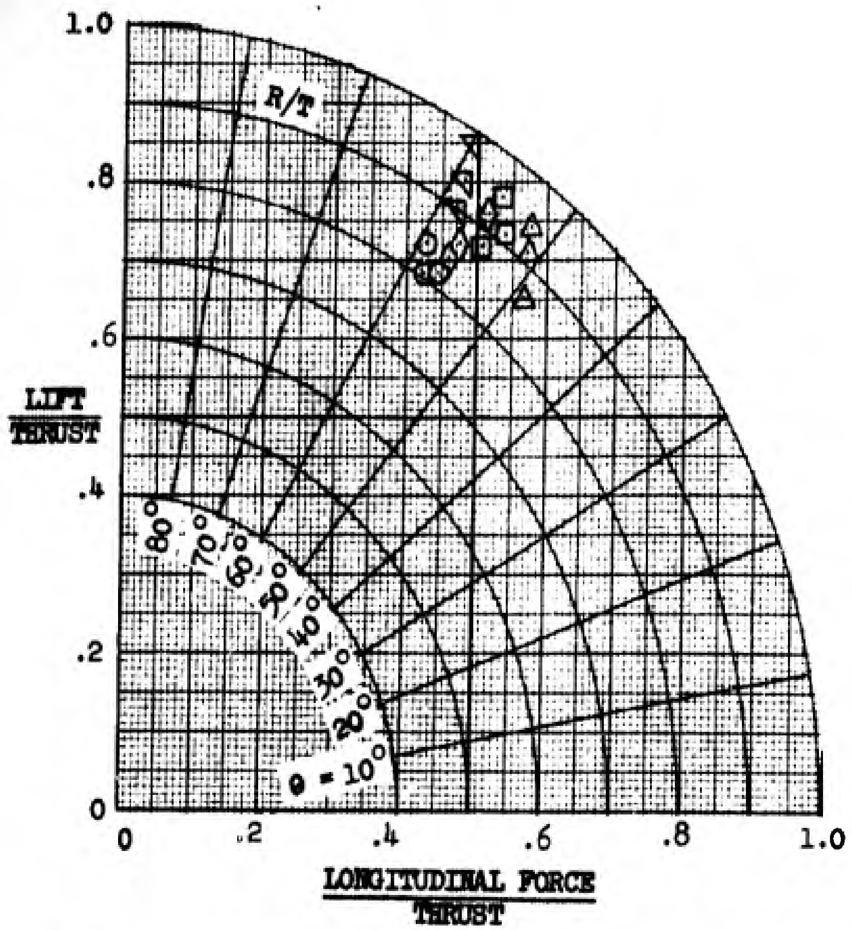
MODEL 88 MONOPLANE CONFIGURATION

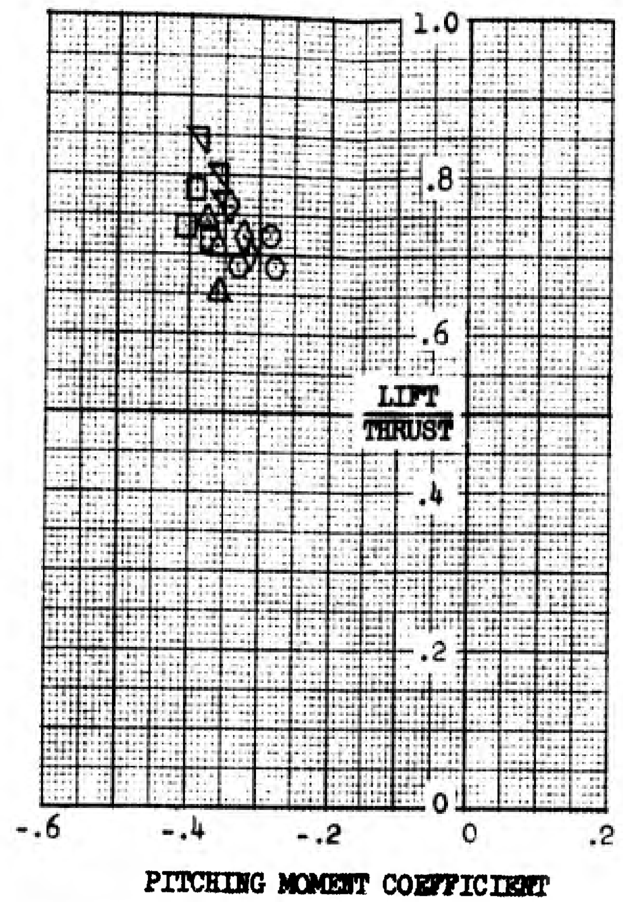
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

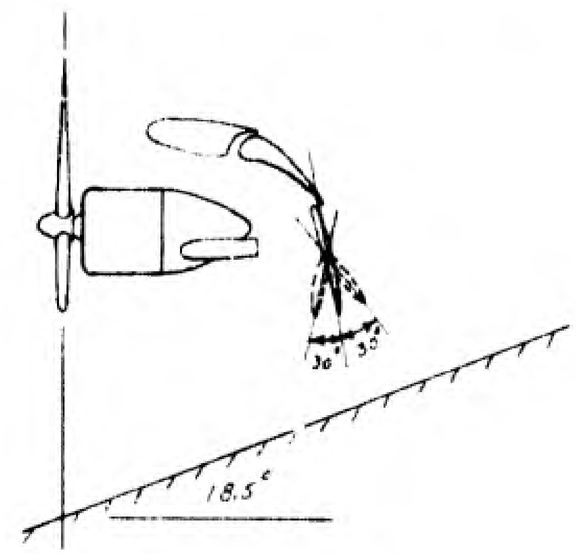
Effect of Control Tab Changes With 30° Forward and Aft Flap Deflection, Ground Plane Installed

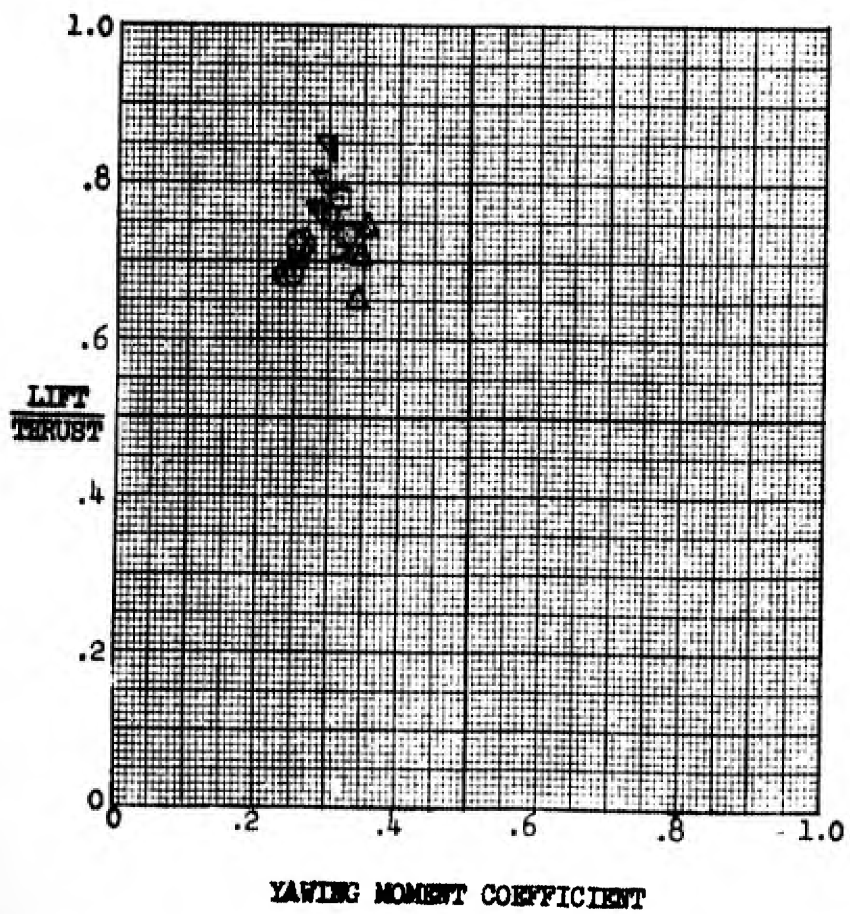
NOTE: Refer to Sketches 11, 12, 13 and 14 of Figure 17 for details.

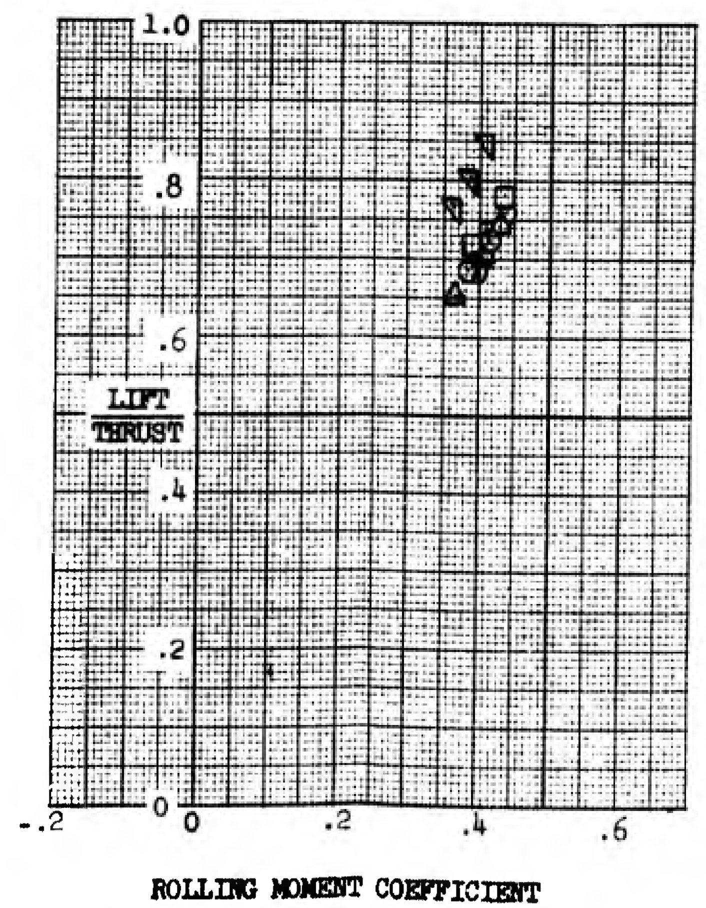
SYM	RUN	TAB
○	70	30° Forward
△	71	30° Aft
□	72	15° Aft
◇	73	15° Forward
◁	16	(Tab Neutral)











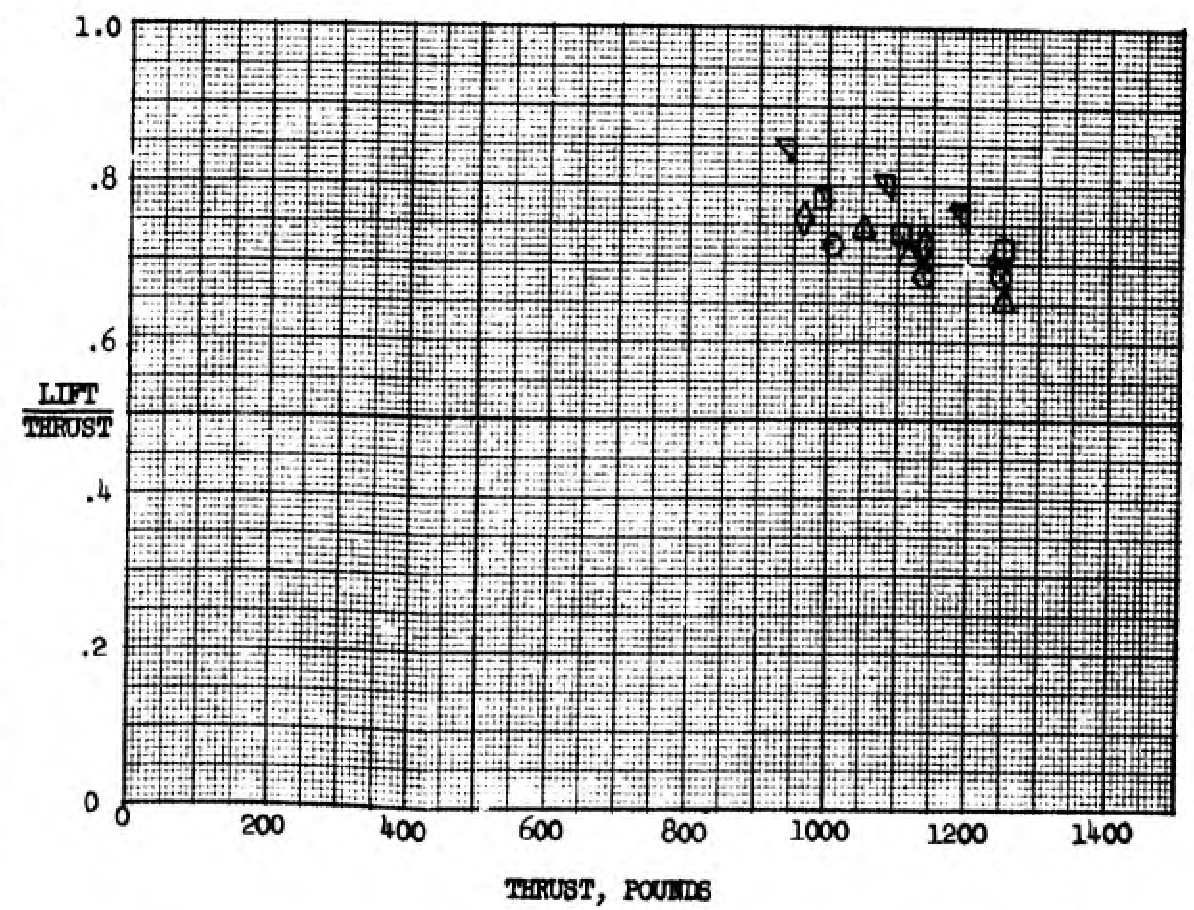
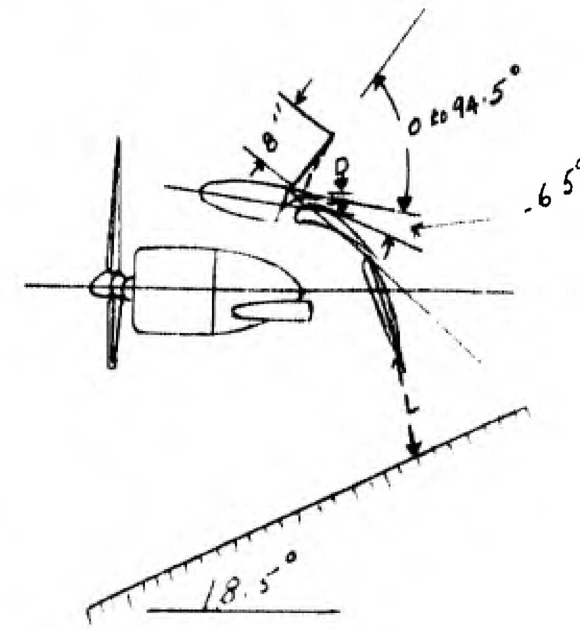


Figure 50

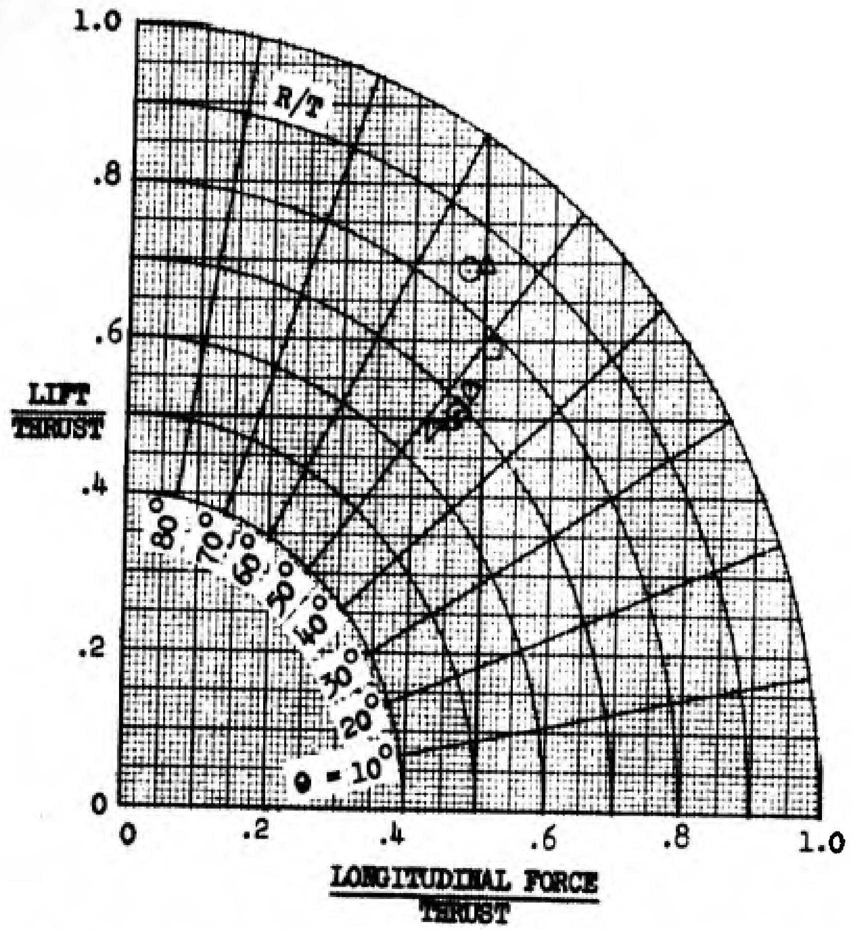
MODEL 88 MONOPLANE CONFIGURATION

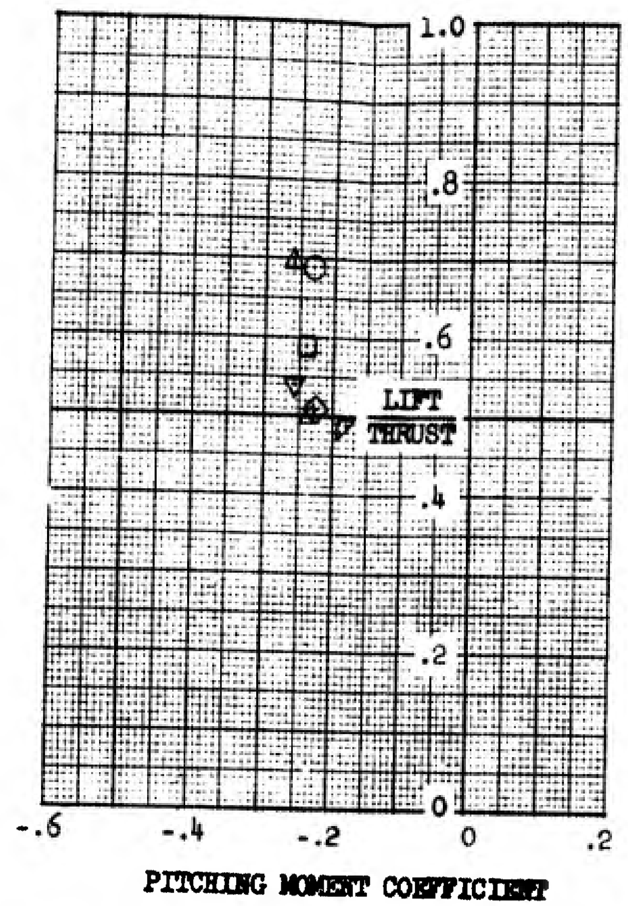
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

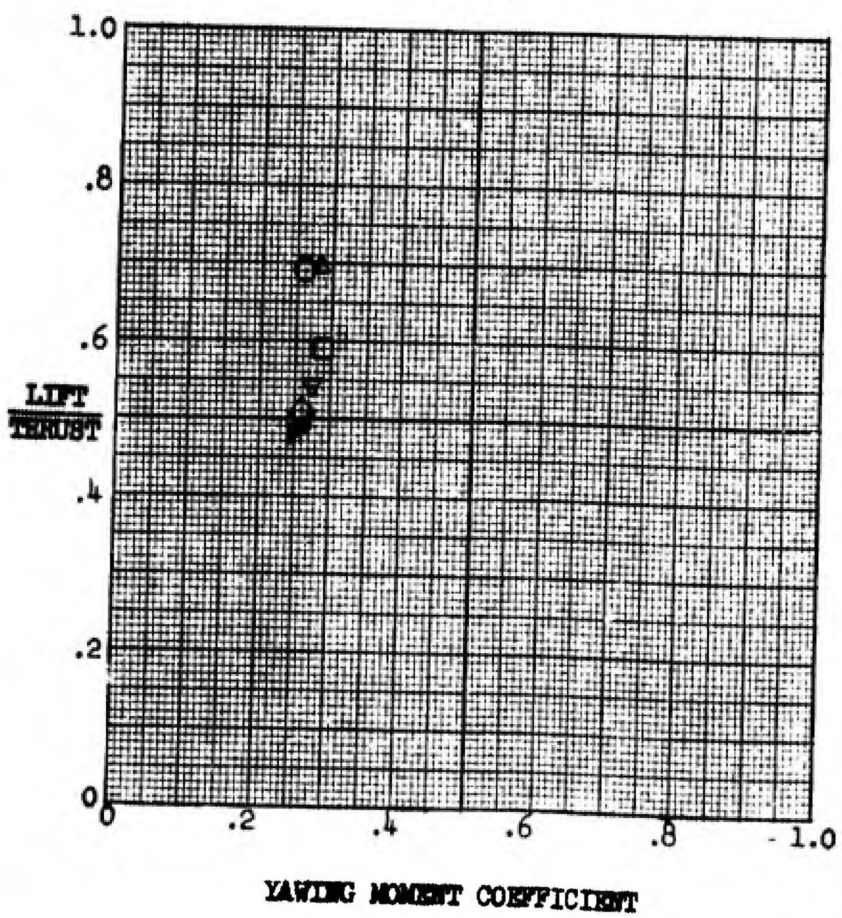
Effect of Spoiler on Top of Wing With Wing at 13° Angle of Incidence And Forward and Aft Flaps Deflected 30°, Ground Plane Installed

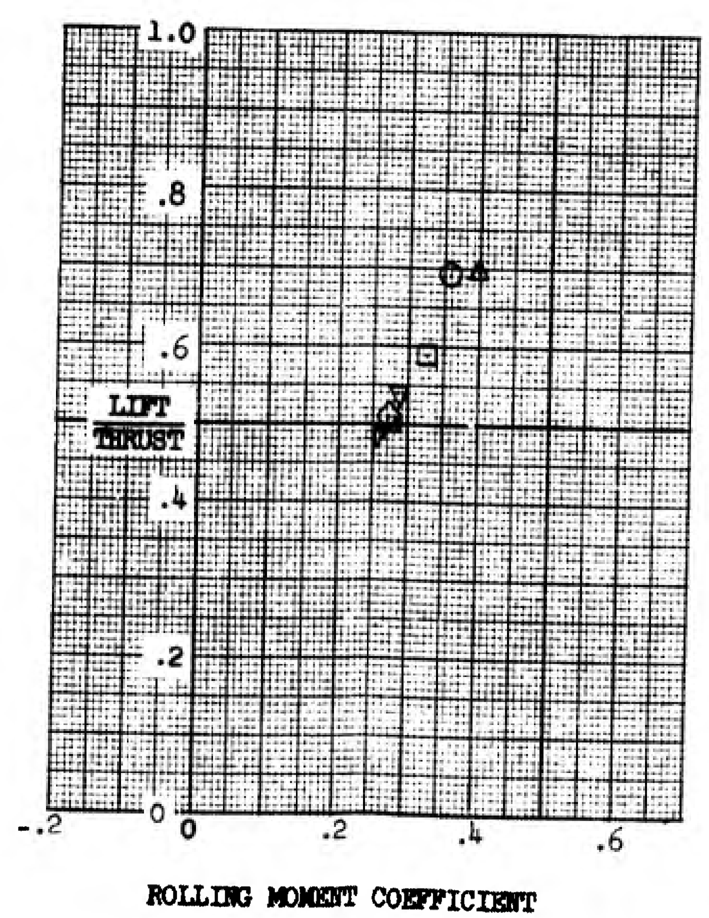


SYM	RUN	SPOILER ANGLE	D
○	74.1	- 6.5	00.06
△	74.2	0	00.90
□	74.3	20.0	3.75
▽	74.4	40.0	6.38
◇	74.5	60.0	8.63
◺	74.6	80.0	10.38
⌐	74.7	94.5	11.50









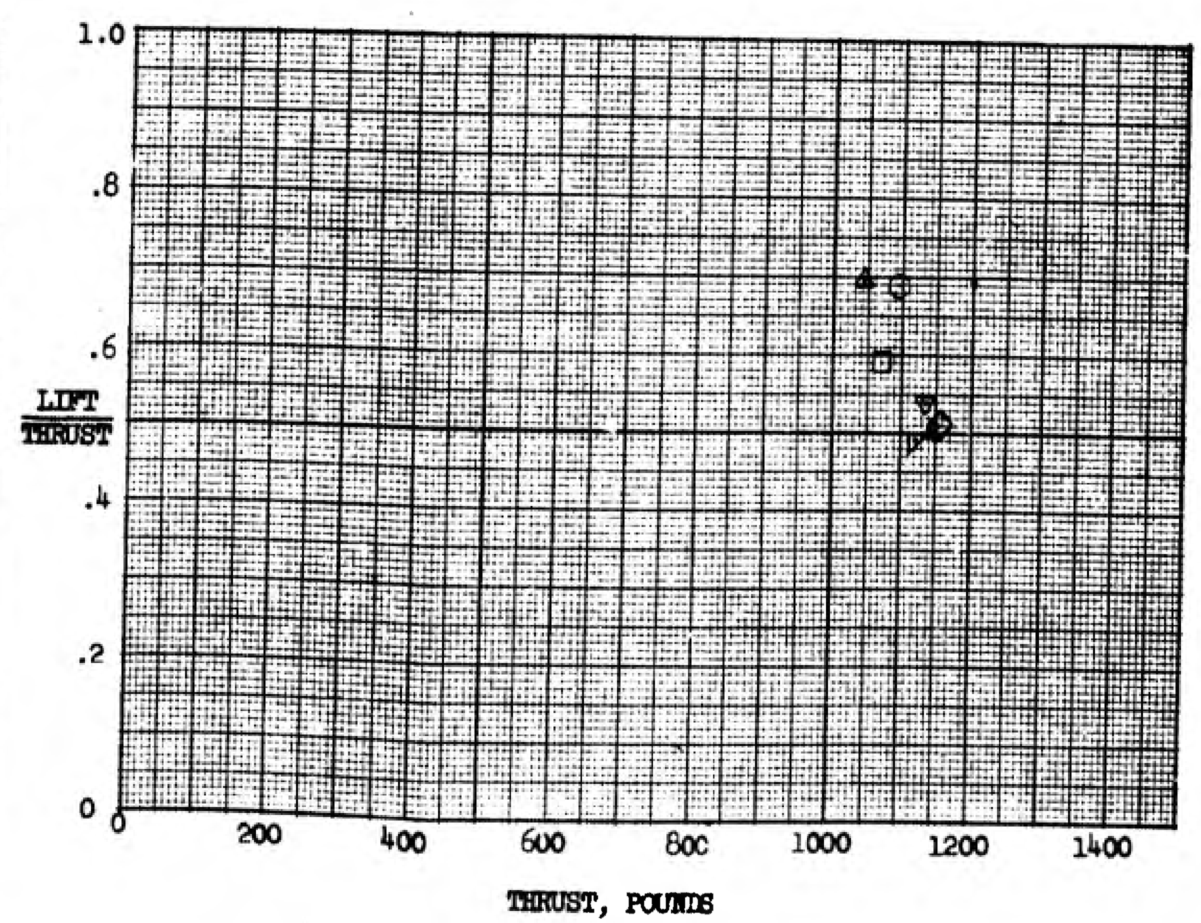


Figure 51

MODEL 88 BIPLANE CONFIGURATION

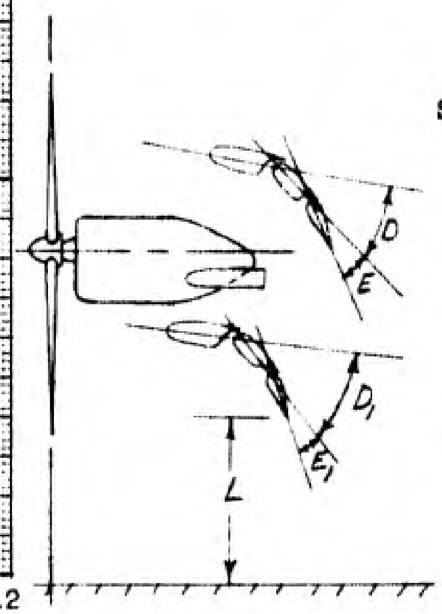
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

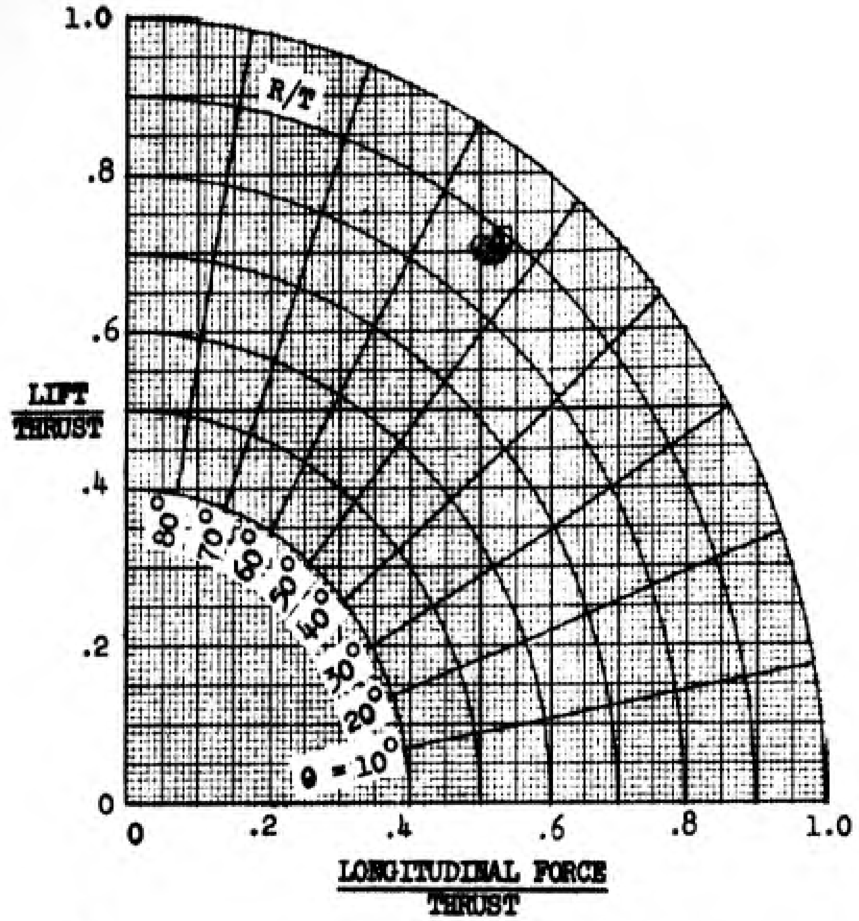
Effect of Upper and Lower Wing-Flaps Deflected Progressively

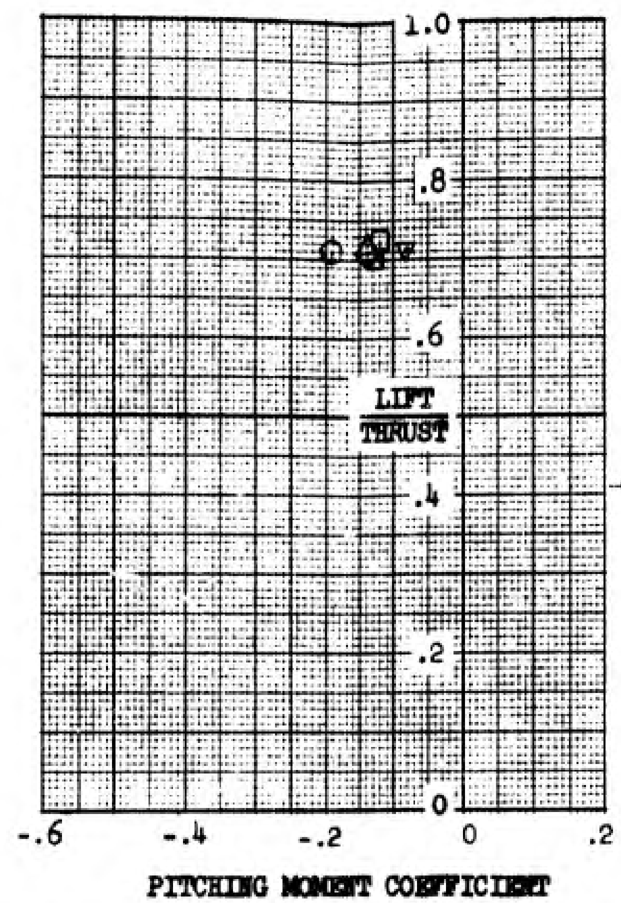
With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

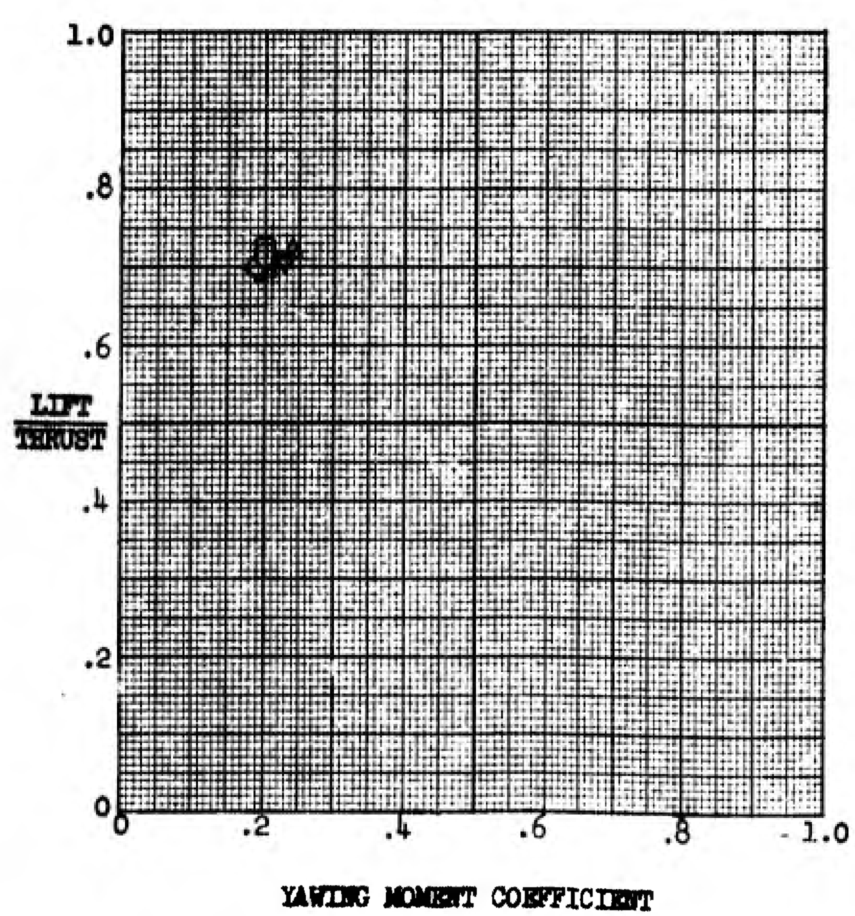
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane removed

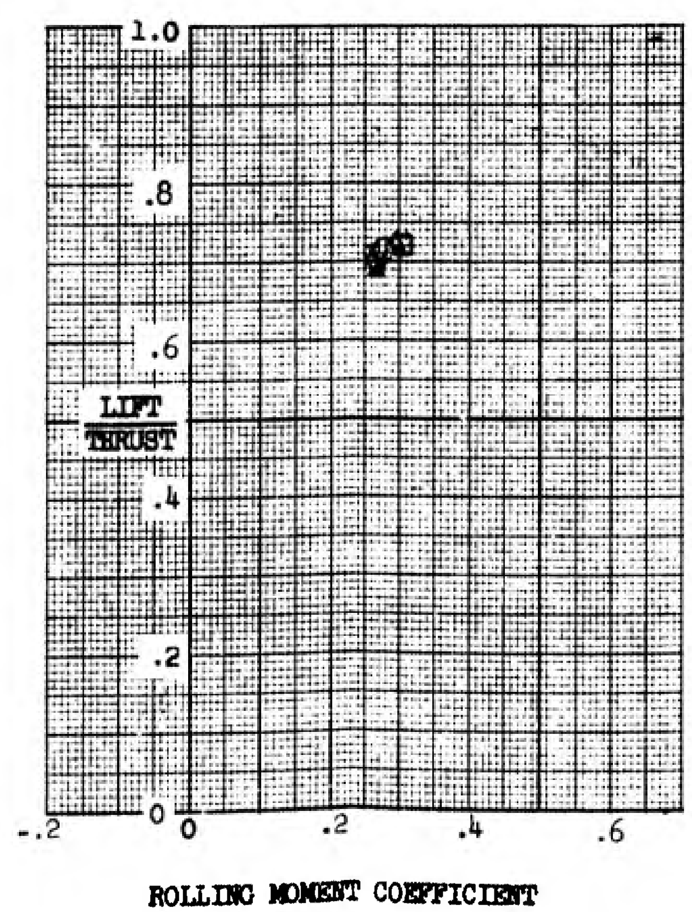
SYMBOL	RUN	D	E	D_1	E_1	L
○	B 23.1	37.50	33.00	42.50	40.50	66.50
△	B 23.2	38.75	35.00	41.25	38.75	66.50
□	B 23.3	40.00	37.00	40.00	37.00	66.50
▽	B 23.4	41.25	38.75	38.75	35.00	66.50
◇	B 23.5	42.50	40.50	37.50	33.00	66.50
⊿	B 23.6	43.75	42.50	36.25	31.00	66.50











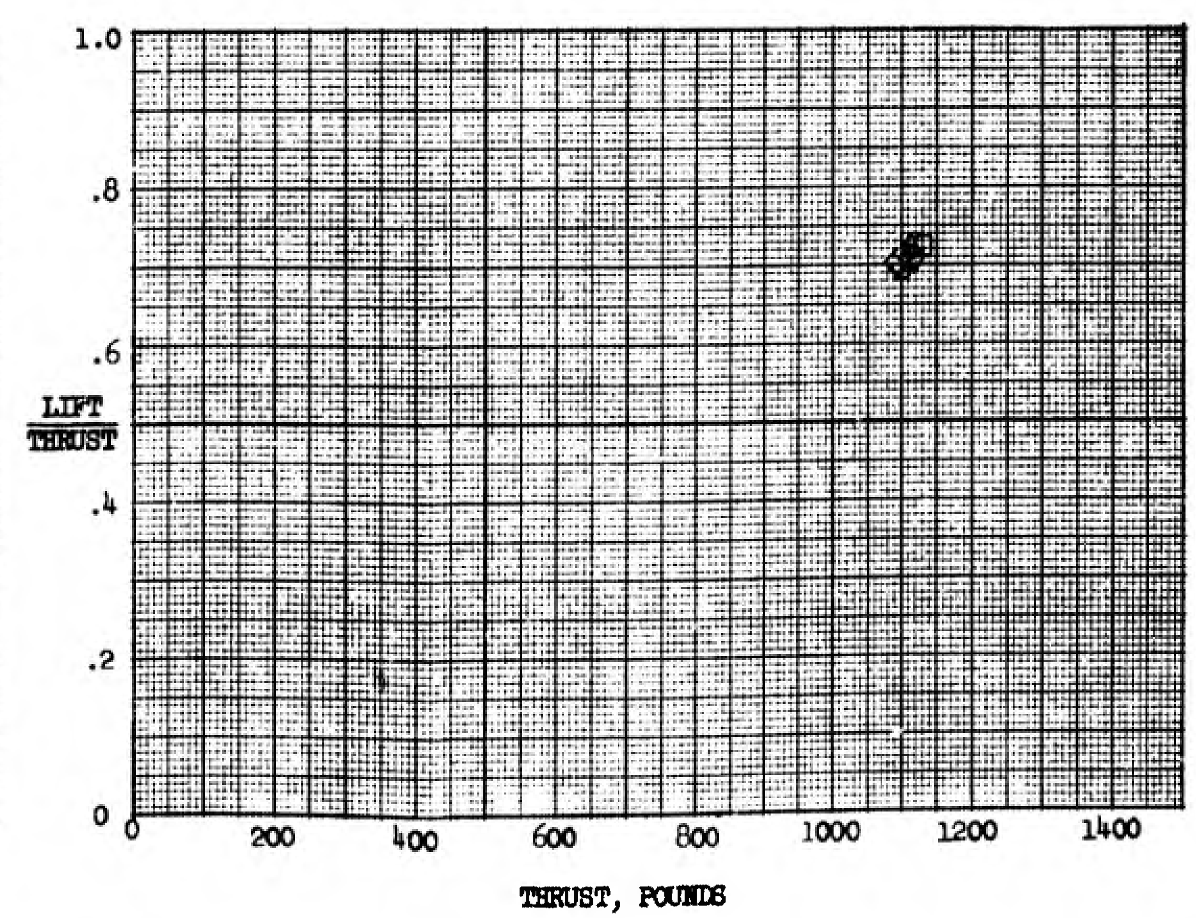


Figure 52

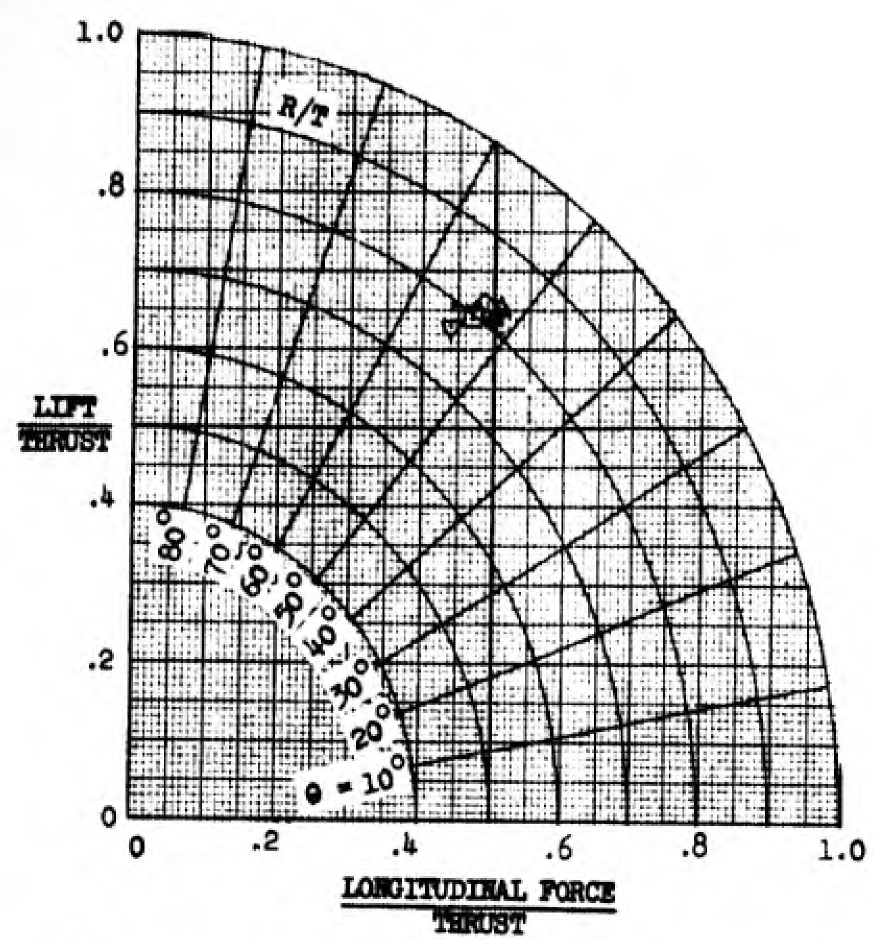
MODEL 88 BIPLANE CONFIGURATION

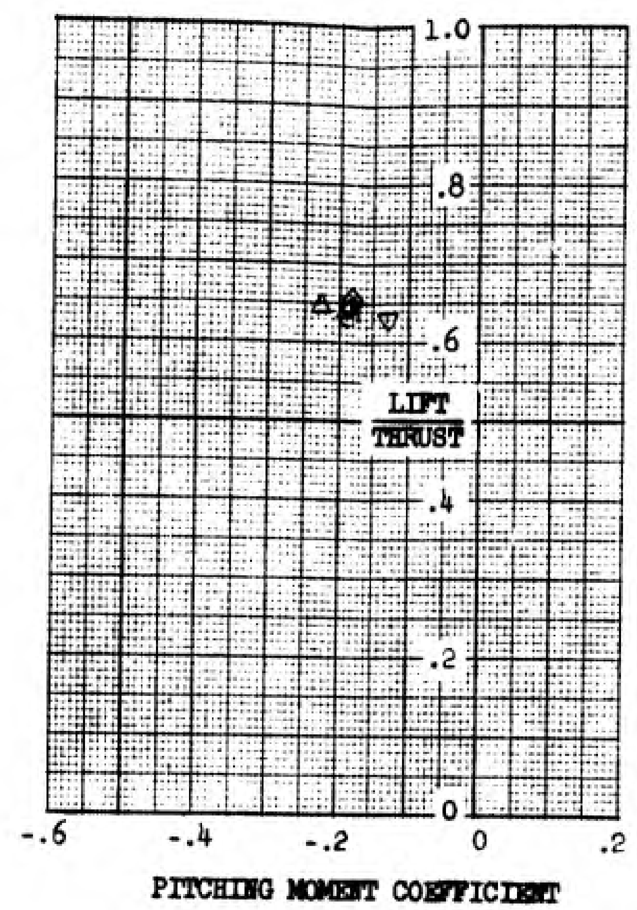
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

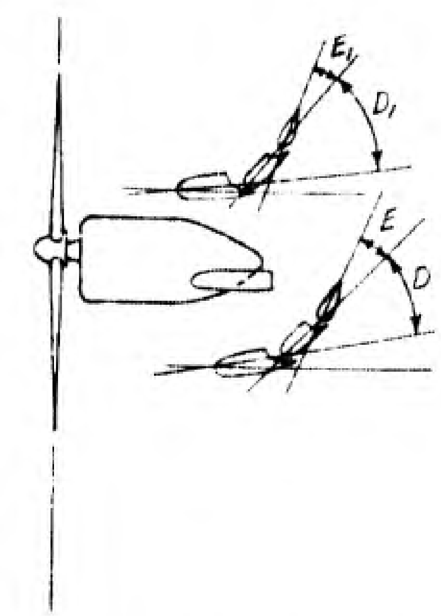
Effect of Upper and Lower Wing Flaps Deflecting Progressively

With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

Test Apparatus Inverted

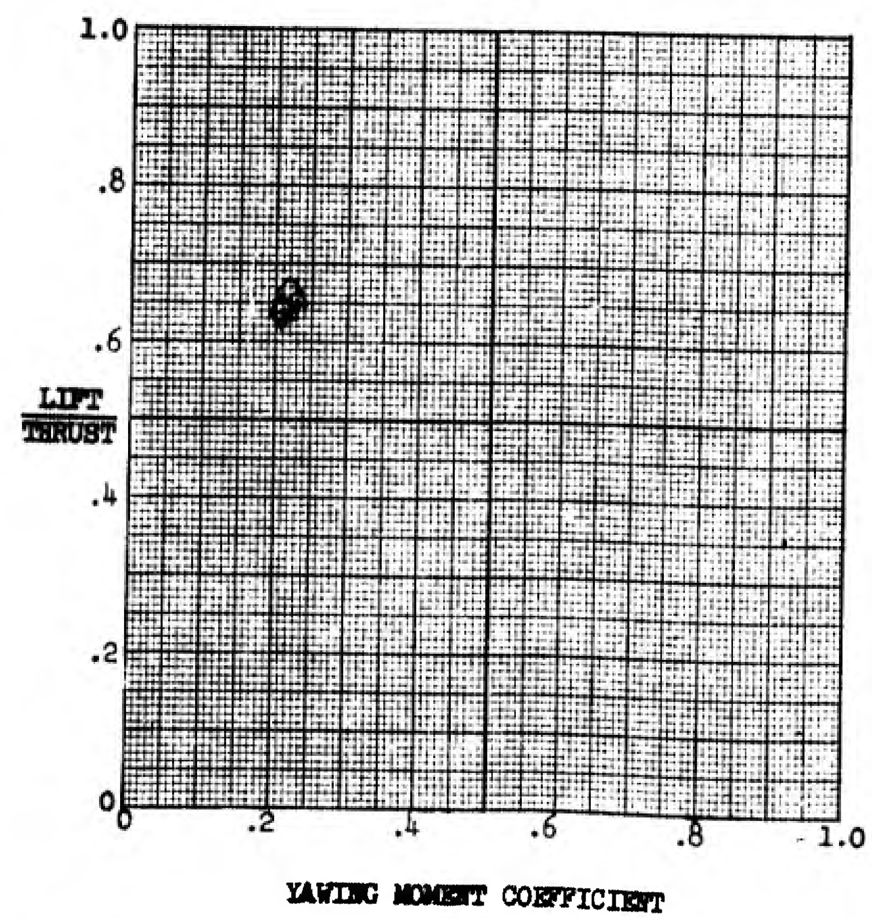


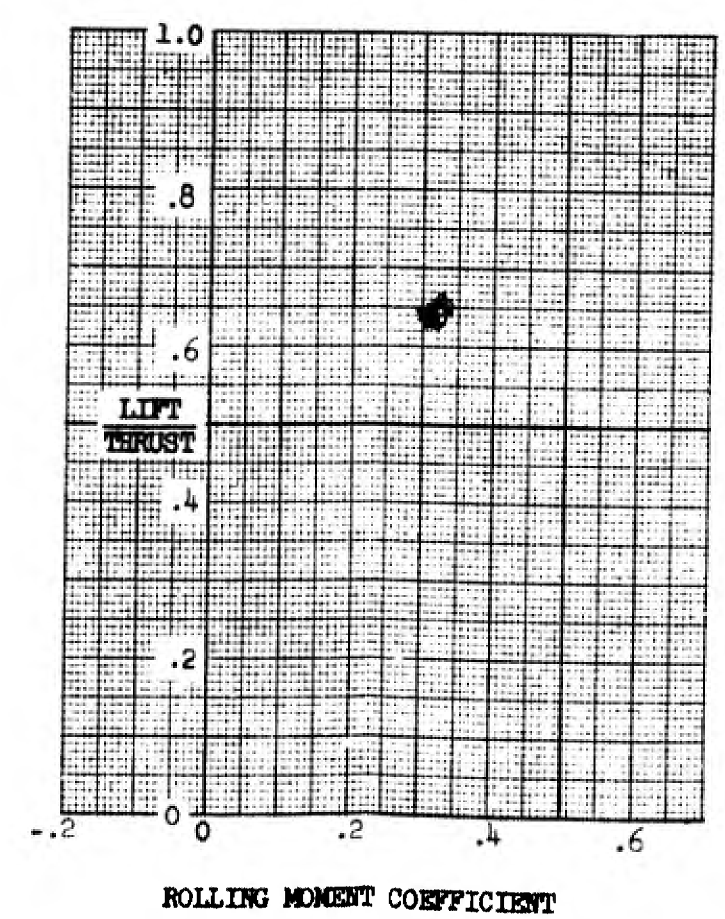




Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane removed

SYMBOL	RUN	D	E	D_1	E_1	L
○	B 24.1	37.50	33.00	42.50	40.50	∞
△	B 24.2	38.75	35.00	41.25	38.75	∞
□	B 24.3	40.00	37.00	40.00	37.00	∞
▽	B 24.4	41.25	38.75	38.75	35.00	∞
◇	B 24.5	42.50	40.50	37.50	33.00	∞
◿	B 24.6	43.75	42.50	36.25	31.00	∞





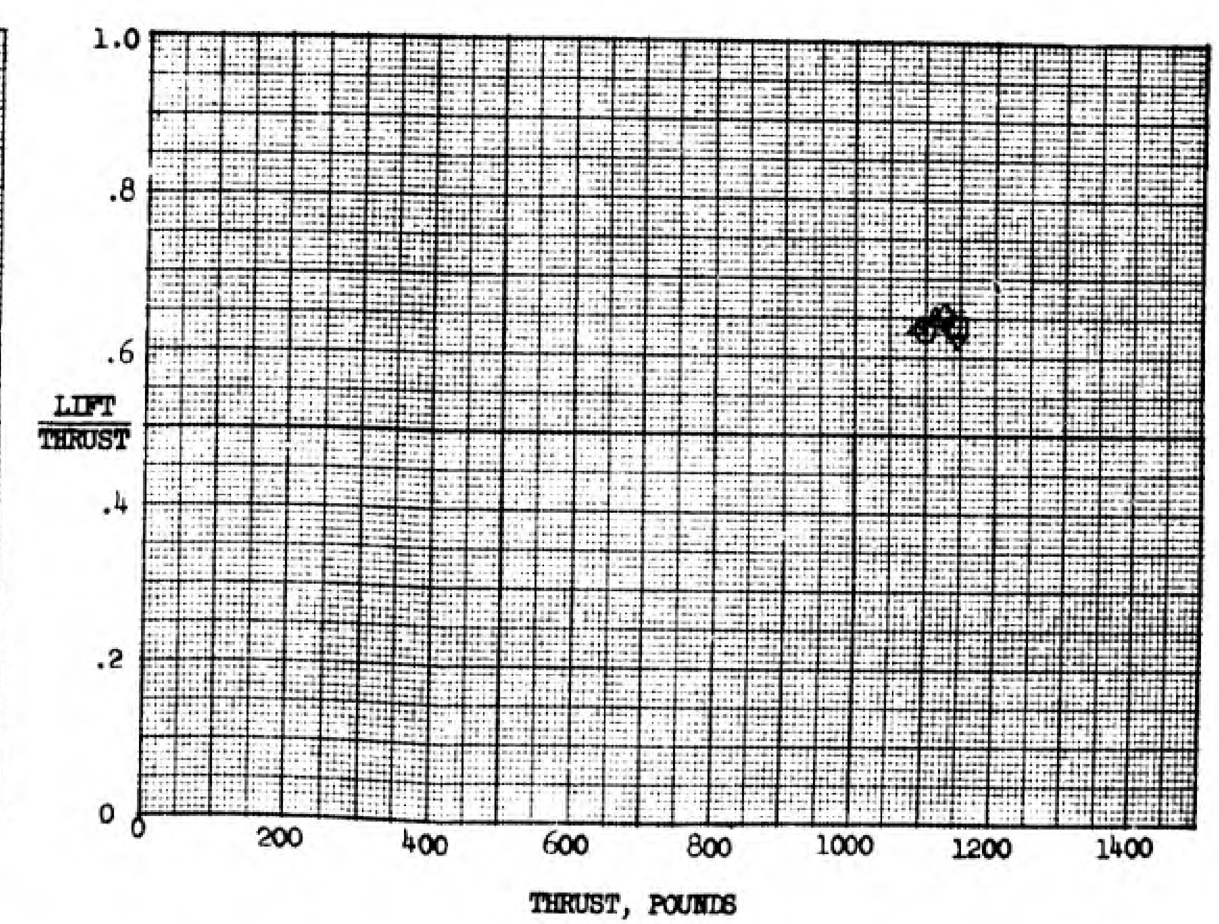


Figure 53

MODEL 88 BIPLANE CONFIGURATION

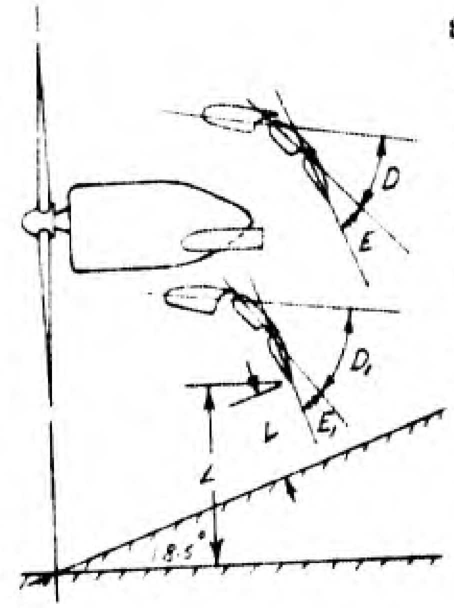
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Ground Plane for Several Flap Deflection Angles

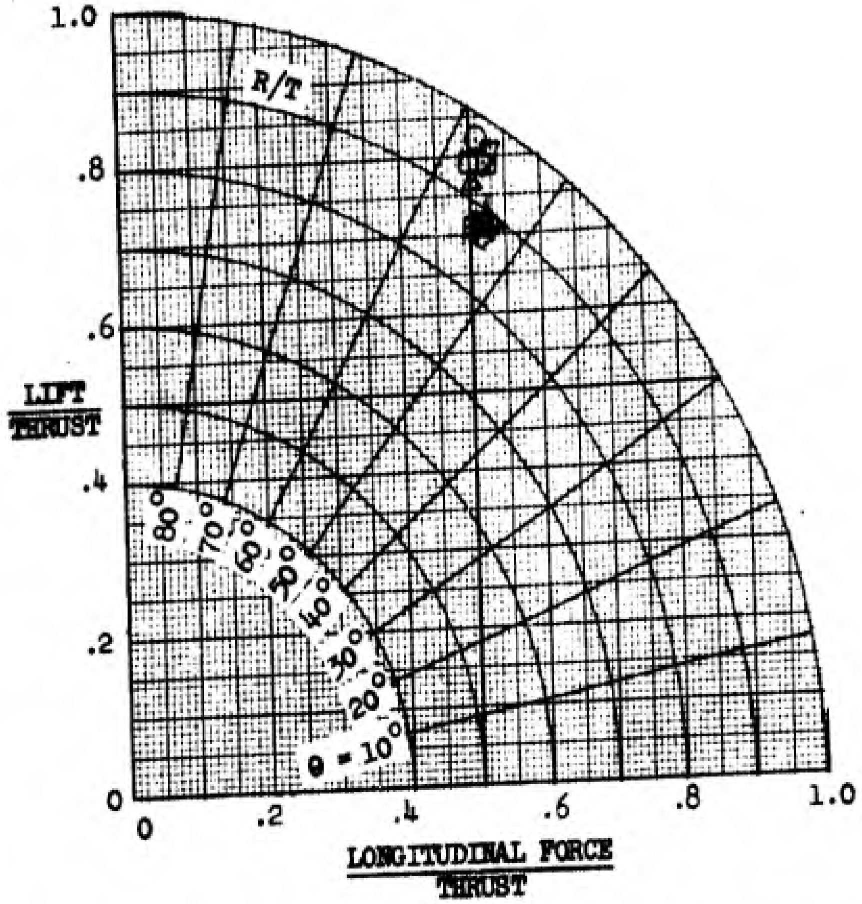
Of Upper and Lower Wing Flaps Deflecting Progressively

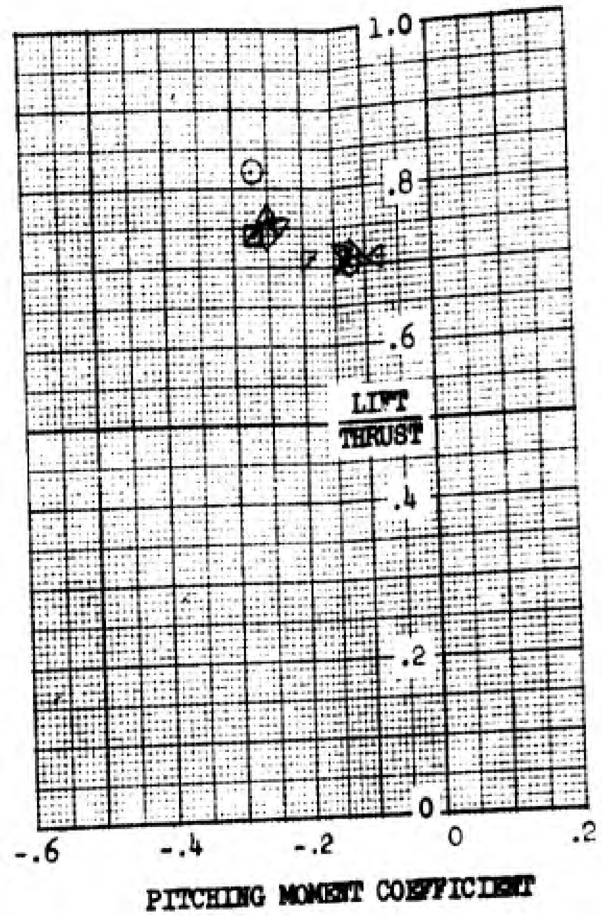
With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

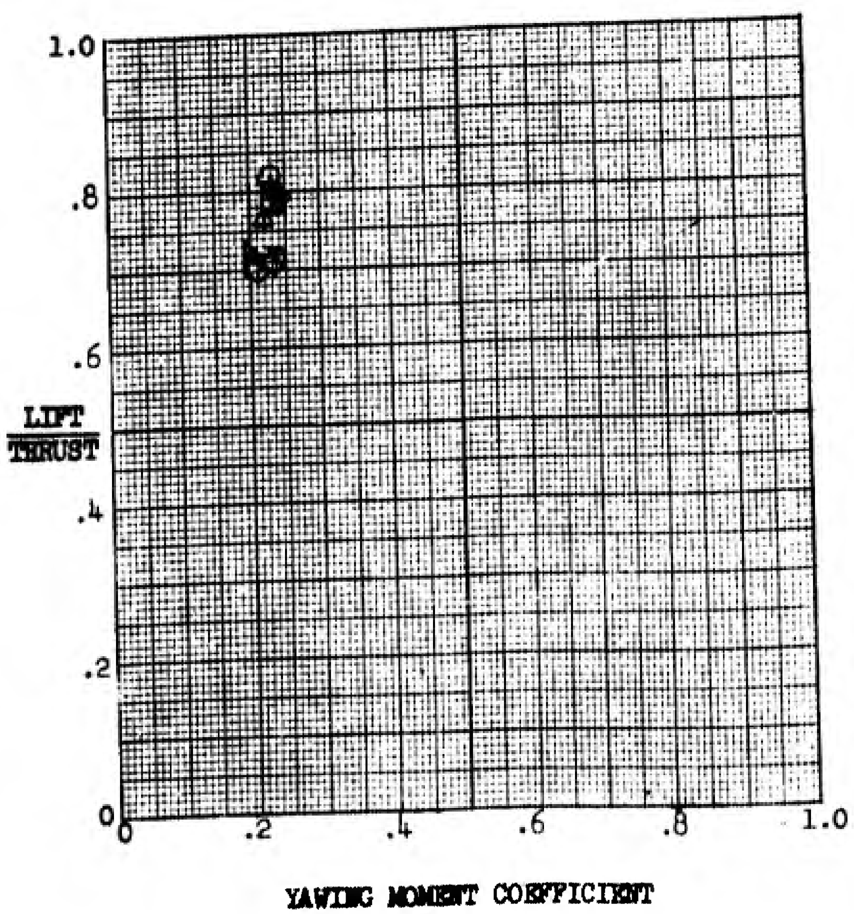
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53

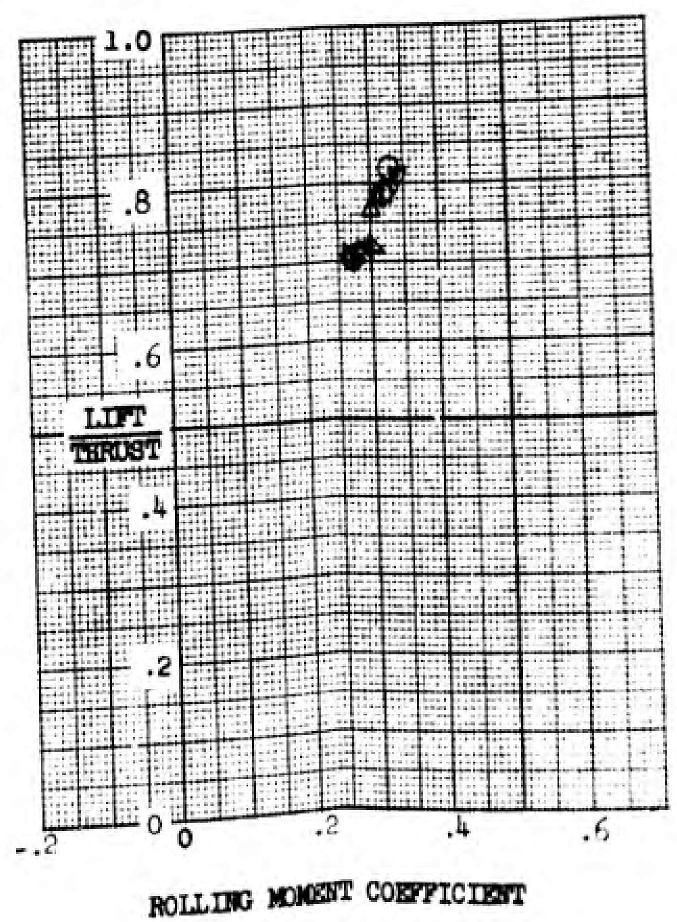


SYM	RUN	D	E	D_1	E_1	L	Grd. Plane
○	B 22.1	37.50	33.00	42.50	40.50	16.00	IN
△	B 22.2	38.75	35.00	41.25	38.75	16.20	IN
□	B 22.3	40.00	37.00	40.00	37.00	16.50	IN
▽	B 22.4	41.25	38.75	38.75	35.00	17.30	IN
◇	B 22.5	42.50	40.50	37.50	33.00	17.50	IN
◁	B 22.6	43.75	42.50	36.25	31.00	18.25	IN
▽	B 23.1	37.50	33.00	42.50	40.50	66.50	OUT
▽	B 23.2	38.75	35.00	41.25	38.75	66.50	OUT
△	B 23.3	40.00	37.00	40.00	37.00	66.50	OUT
◁	B 23.4	41.25	38.75	38.75	35.00	66.50	OUT
○	B 23.5	42.50	40.50	37.50	33.00	66.50	OUT
◇	B 23.6	43.75	42.50	36.25	31.00	66.50	OUT









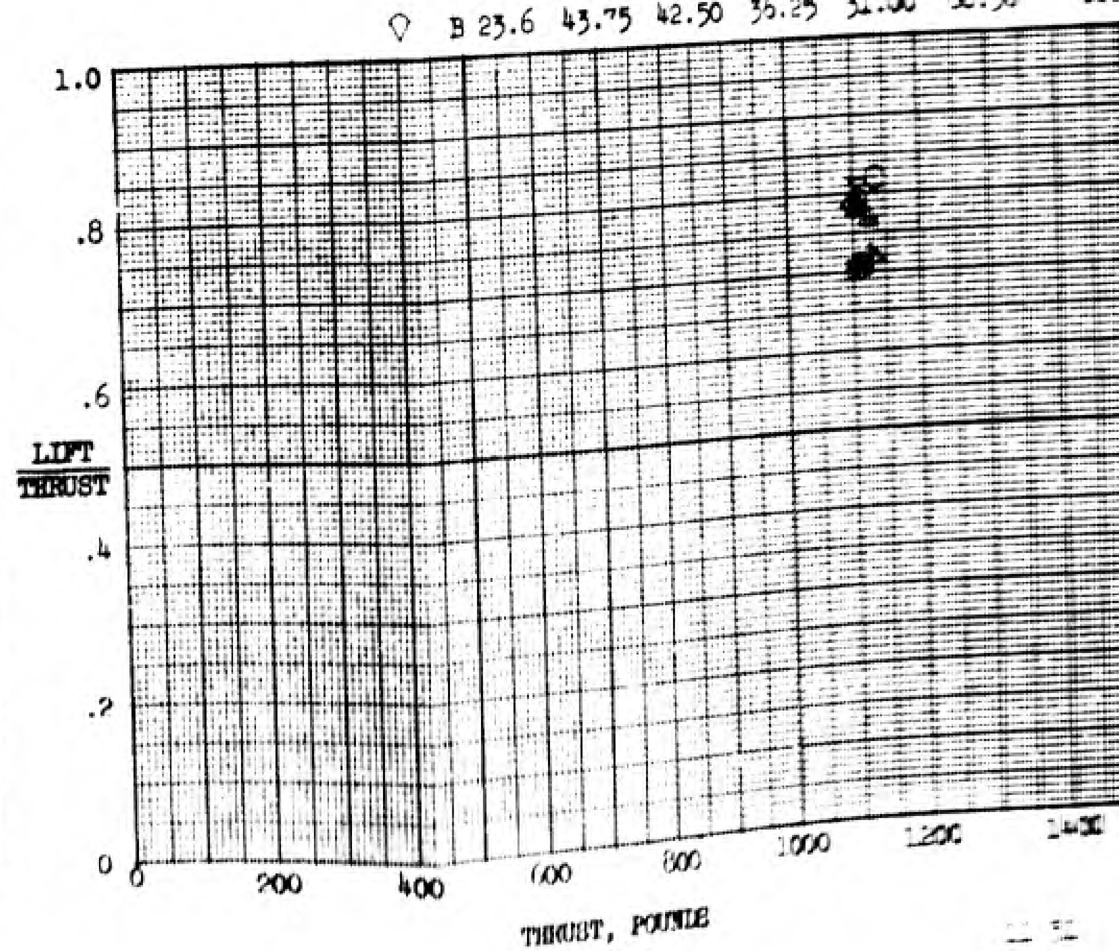


Figure 54

MODEL 88 BIPLANE CONFIGURATION

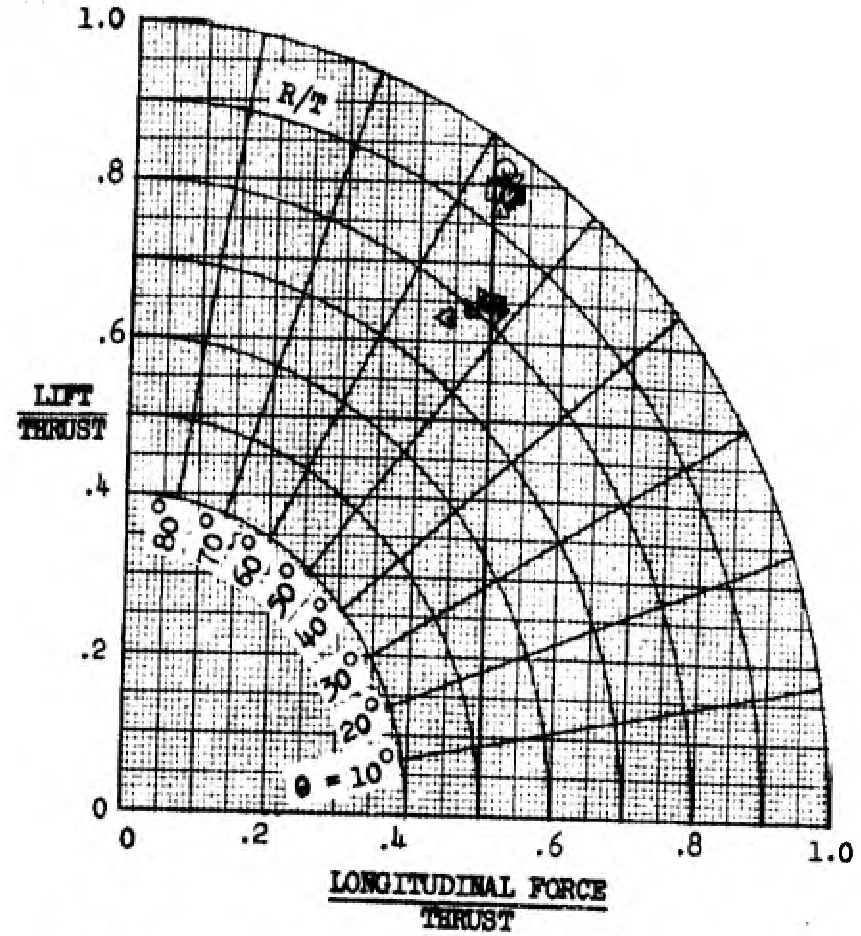
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

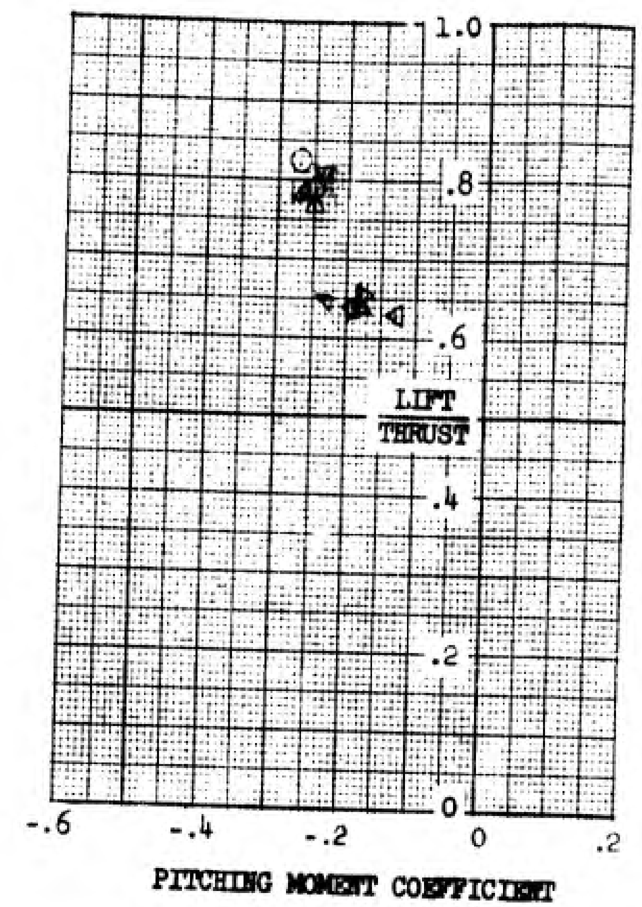
Effect of Ground Plane at an Infinite Distance for Several Flap Deflection Angles of Upper and Lower Wing-Flaps Deflecting Progressively With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

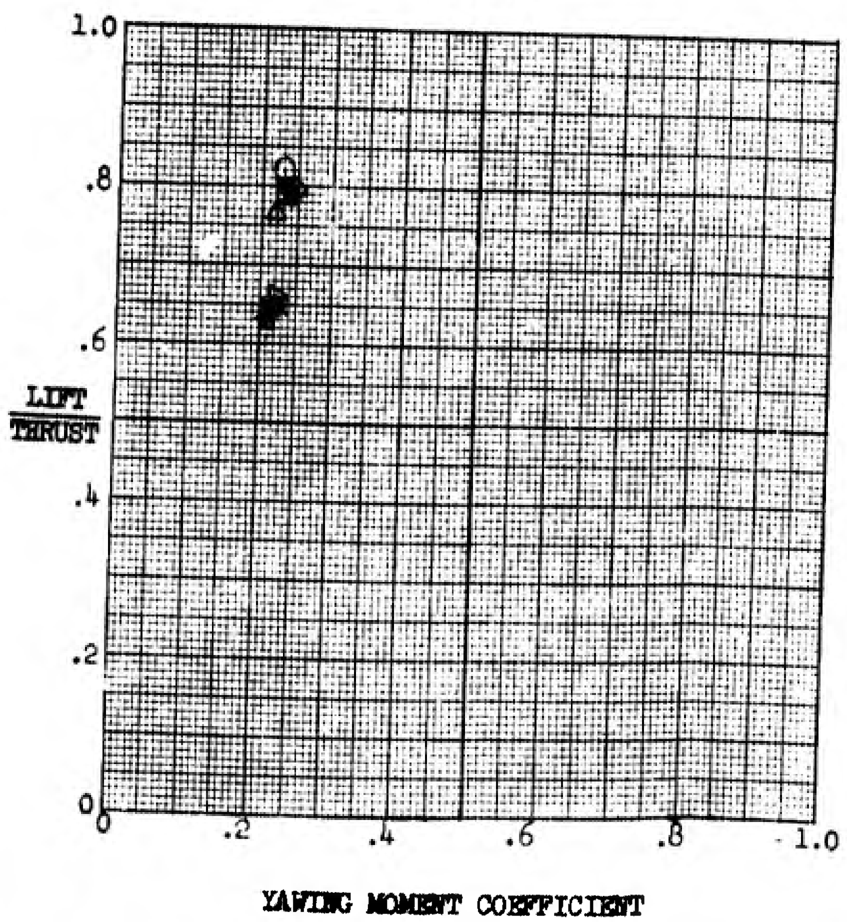
NOTE: Refer to the sketch on Figure 55 for details of ground plane installed and to the sketch on Figure 52 for details of test apparatus inverted.

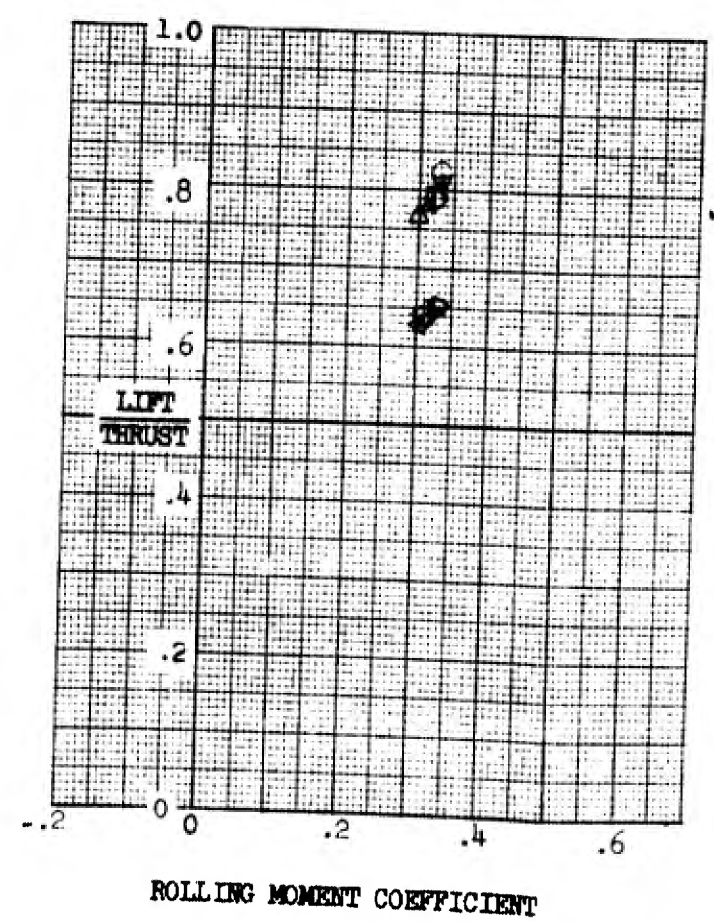
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53

SYM	RUN	D	E	D_1	E_1	L	Grd. Plane
○	B 22.1	37.50	33.00	42.50	40.50	16.00	IN
△	B 22.2	38.75	35.00	41.25	38.75	16.20	IN
□	B 22.3	40.00	37.00	40.00	37.00	16.50	IN
▽	B 22.4	41.25	38.75	38.75	35.00	17.30	IN
◇	B 22.5	42.50	40.50	37.50	33.00	17.50	IN
◁	B 22.6	43.75	42.50	36.25	31.00	18.25	IN
▽	B 24.1	37.50	33.00	42.50	40.50	∞	OUT
⌝	B 24.2	38.75	35.00	41.25	38.75	∞	OUT
└	B 24.3	40.00	37.00	40.00	37.00	∞	OUT
<	B 24.4	41.25	38.75	38.75	35.00	∞	OUT
▷	B 24.5	42.50	40.50	37.50	33.00	∞	OUT
○	B 24.6	43.75	42.50	36.25	31.00	∞	OUT









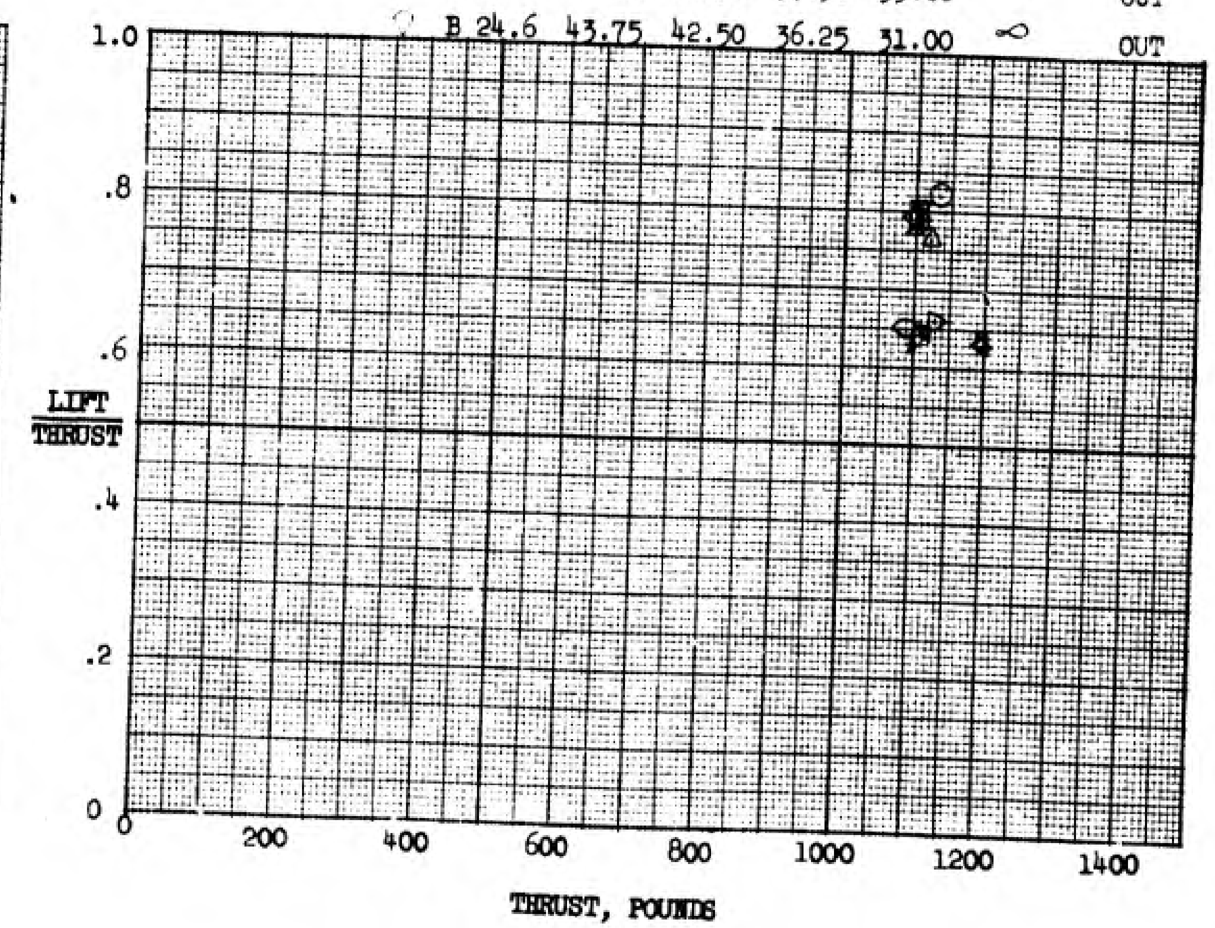


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Figure 55

MODEL 88 BIPLANE CONFIGURATION

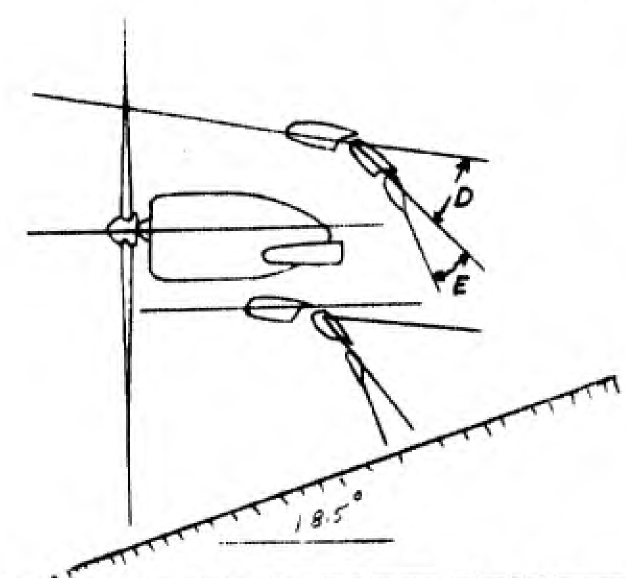
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

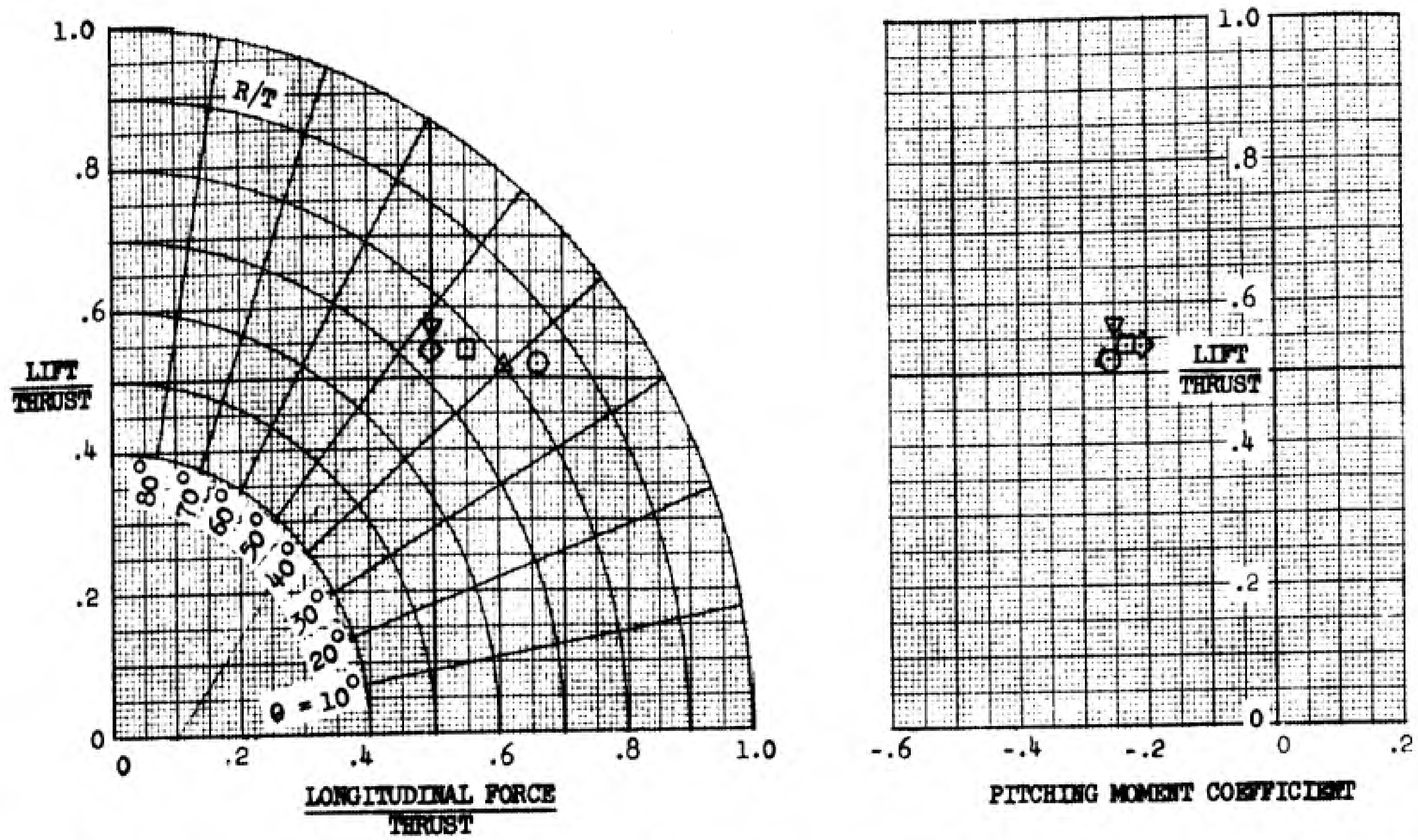
Effect of Upper Wing Flaps with Upper and Lower Wings

At 5° Angle of Incidence

Lower wing forward flap = 50° deflection
Lower wing aft flap = 51° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

SYMBOL	RUN	D	E
○	B 1.1	35.00	29.00
	B 1.2	40.00	37.00
□	B 1.3	45.00	44.00
	B 1.4	50.00	51.00
◇	B 1.5	55.00	58.50





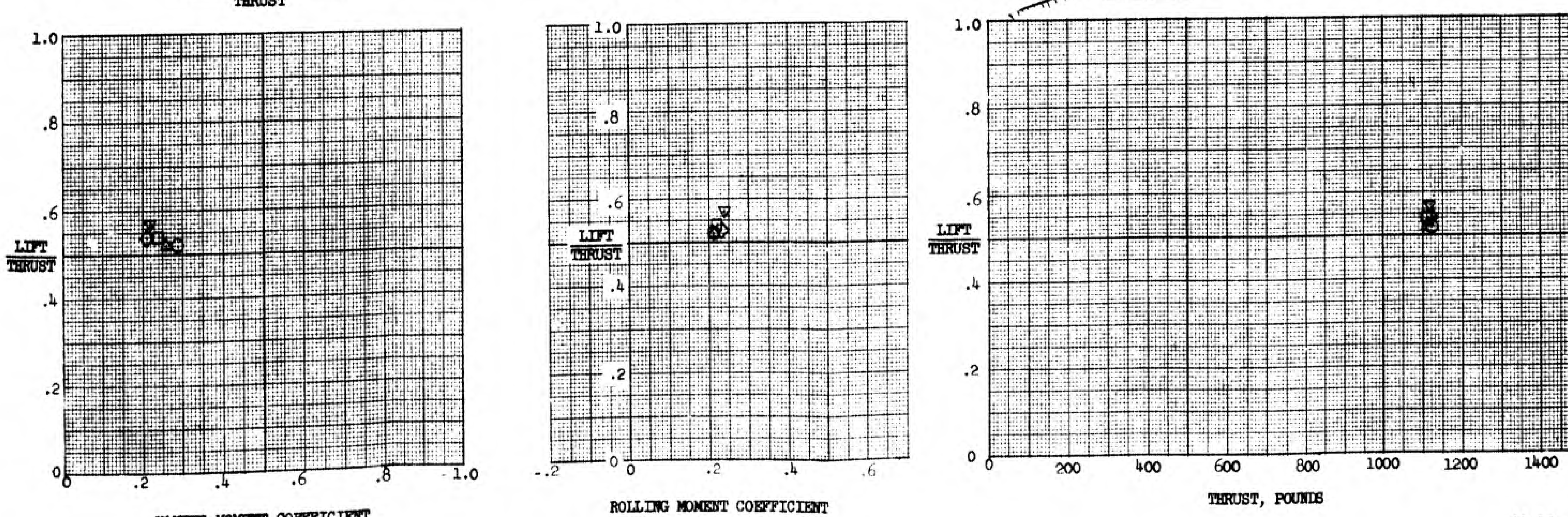


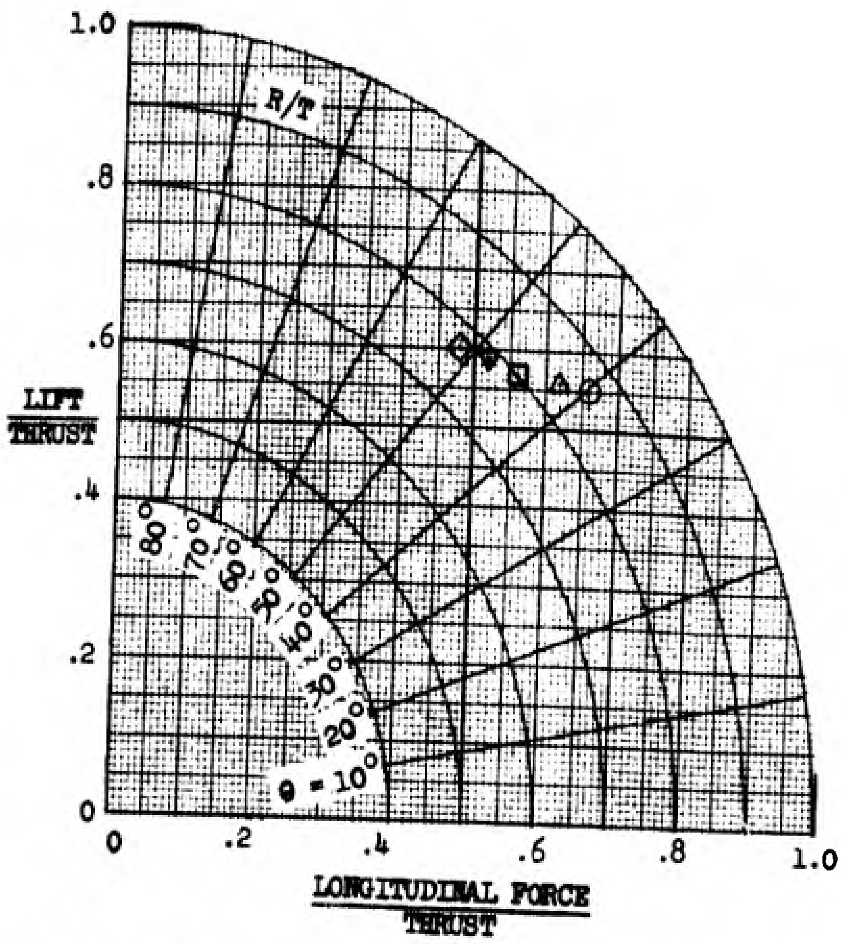
Figure 56

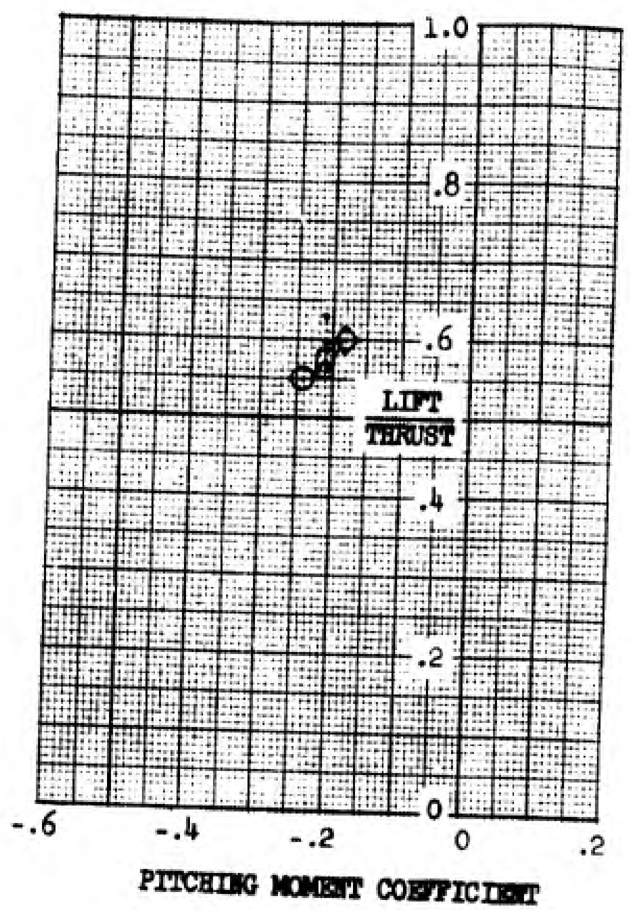
MODEL 88 BIPLANE CONFIGURATION

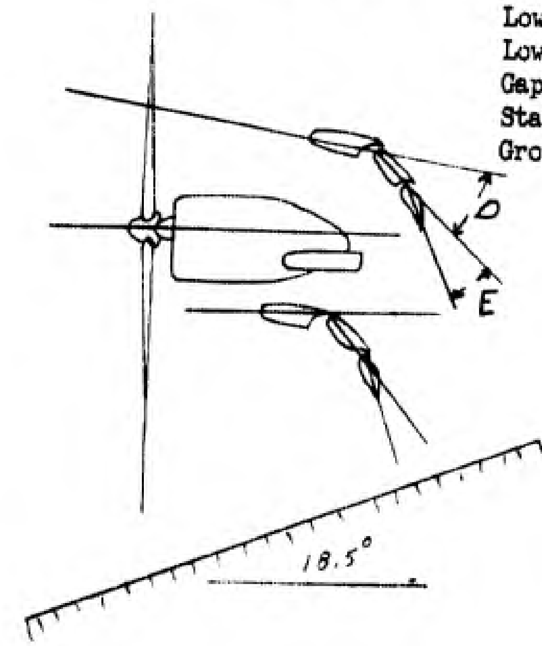
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Upper Wing Flaps with Upper Wing at 10°

And Lower Wing at 5° Angle of Incidence

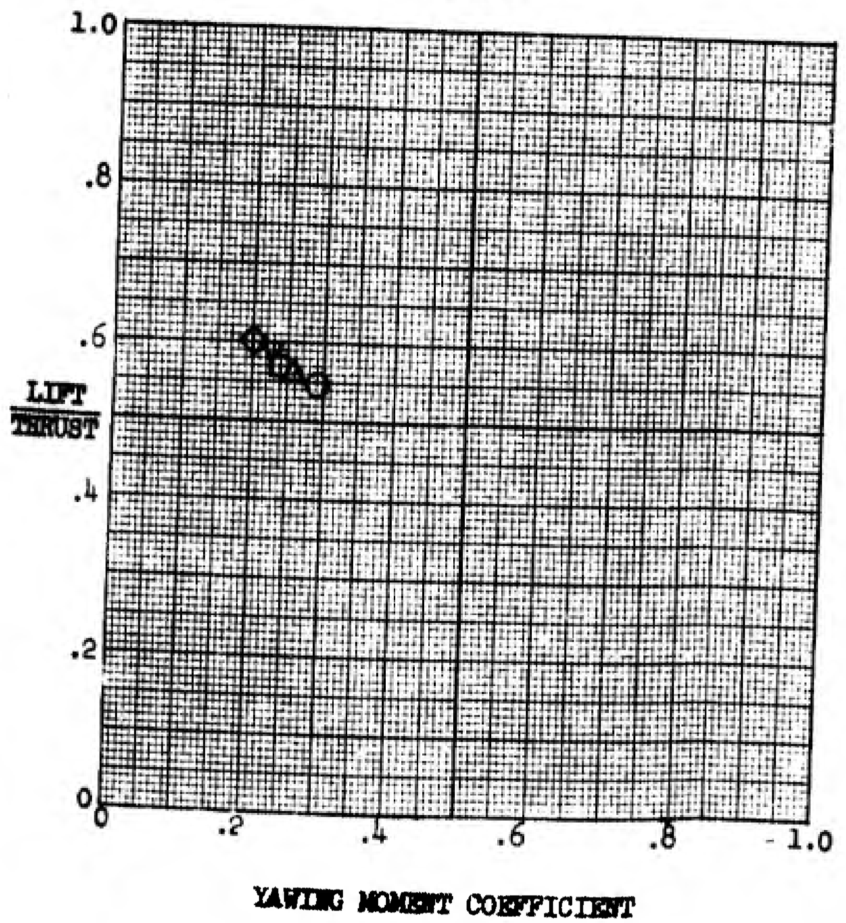


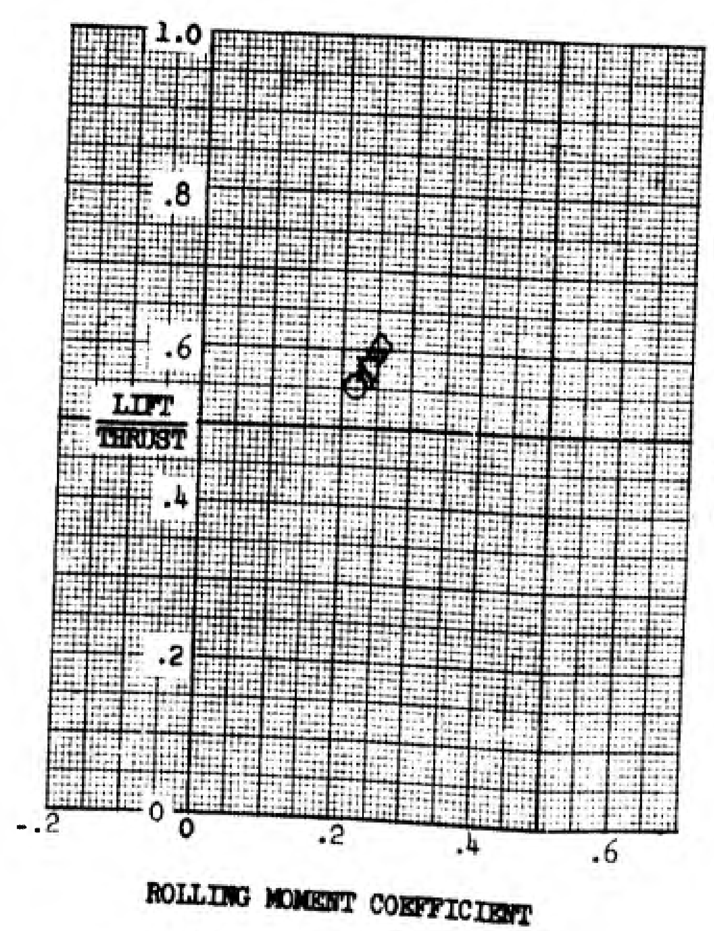




Lower wing forward flap = 50° deflection
Lower wing aft flap = 51° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

SYM	RUN	D	E
○	B 2.1	30.00	21.00
△	B 2.2	35.00	29.00
□	B 2.3	40.00	37.00
▽	B 2.4	45.00	44.00
◇	B 2.5	50.00	51.00





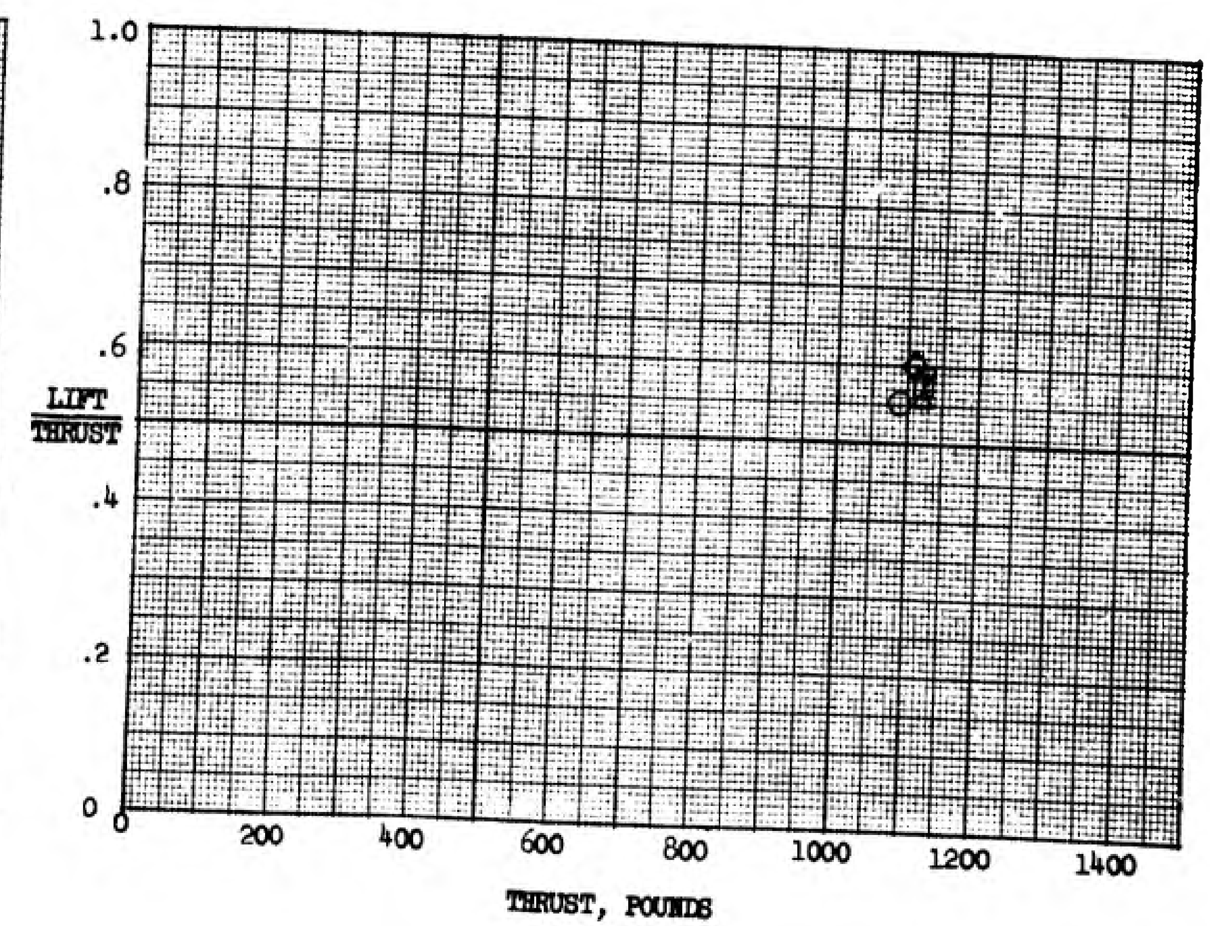


Figure 57

MODEL 88 BIPLANE CONFIGURATION

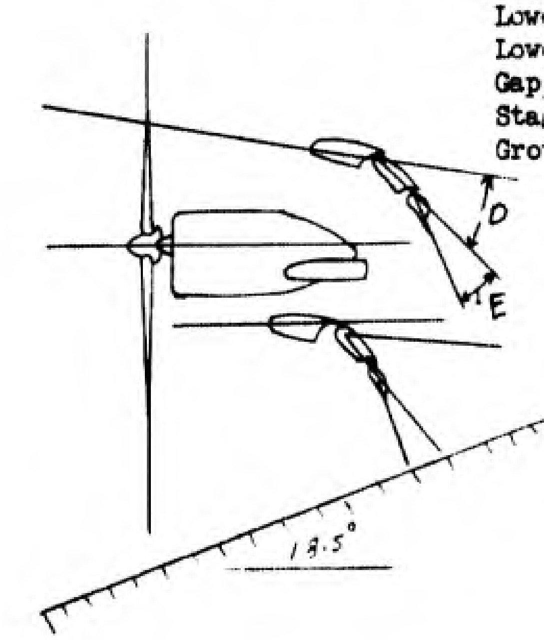
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

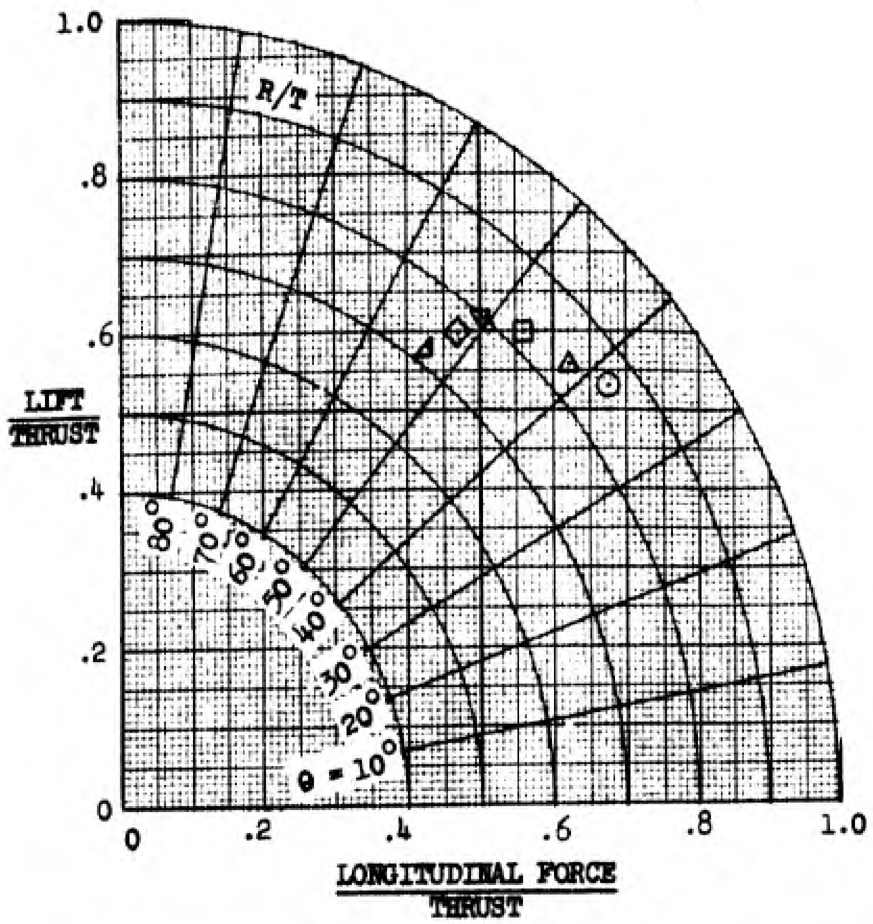
Effect of Upper Wing Flaps with Upper Wing at 25°

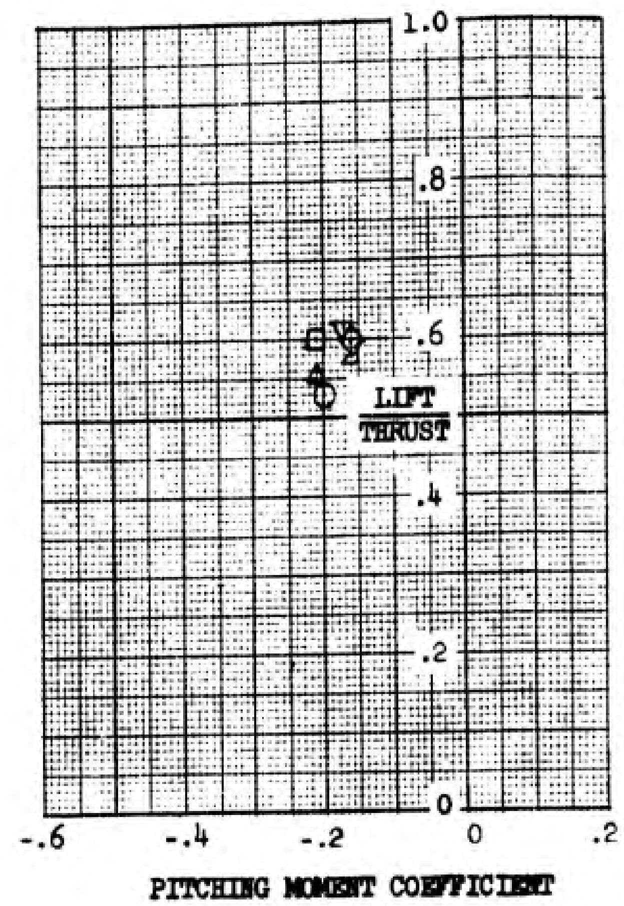
And Lower Wing at 5° Angle of Incidence

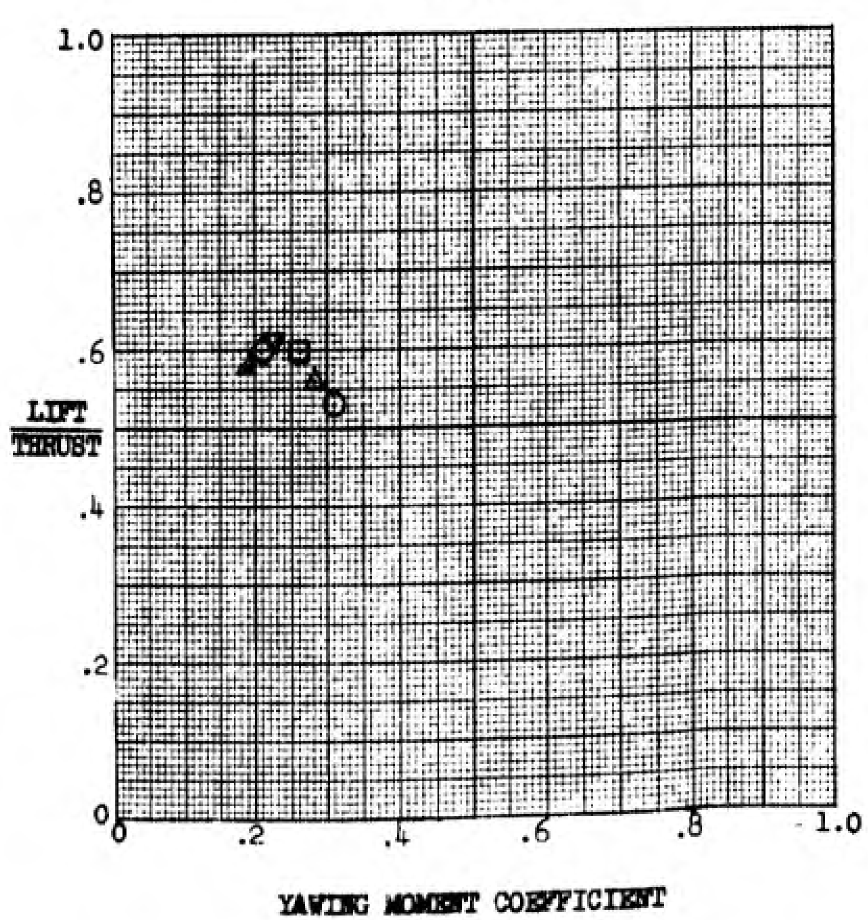
Lower wing forward flap = 50° deflection
Lower wing aft flap = 51° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

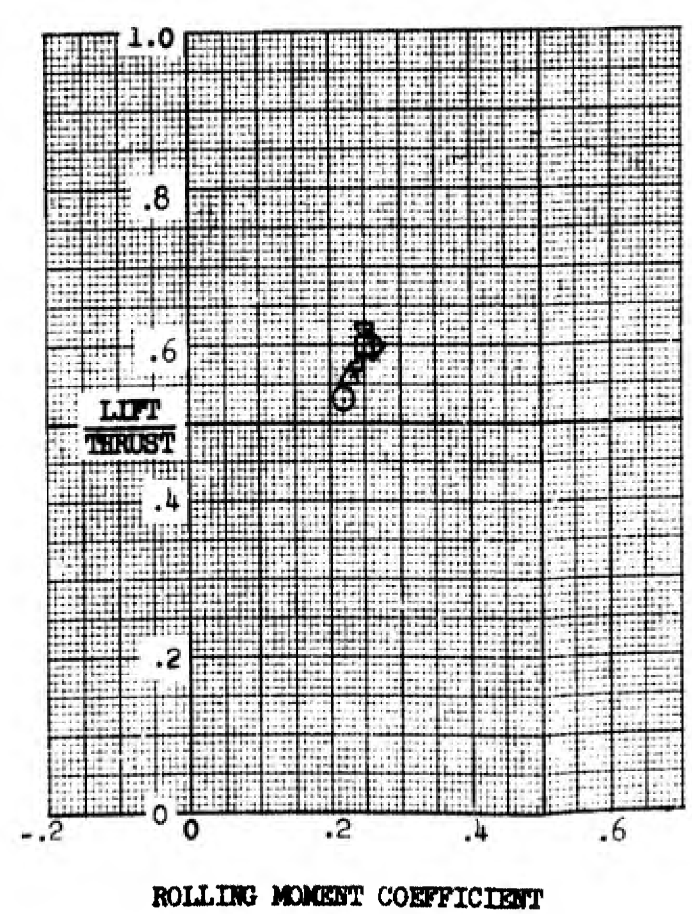
SYM	RUN	D	E
	B 3.1	20.00	8.00
△	B 3.2	25.00	14.50
□	B 3.3	30.00	21.00
▽	B 3.4	35.00	29.00
◇	B 3.5	40.00	37.00
⊿	B 3.6	45.00	44.00











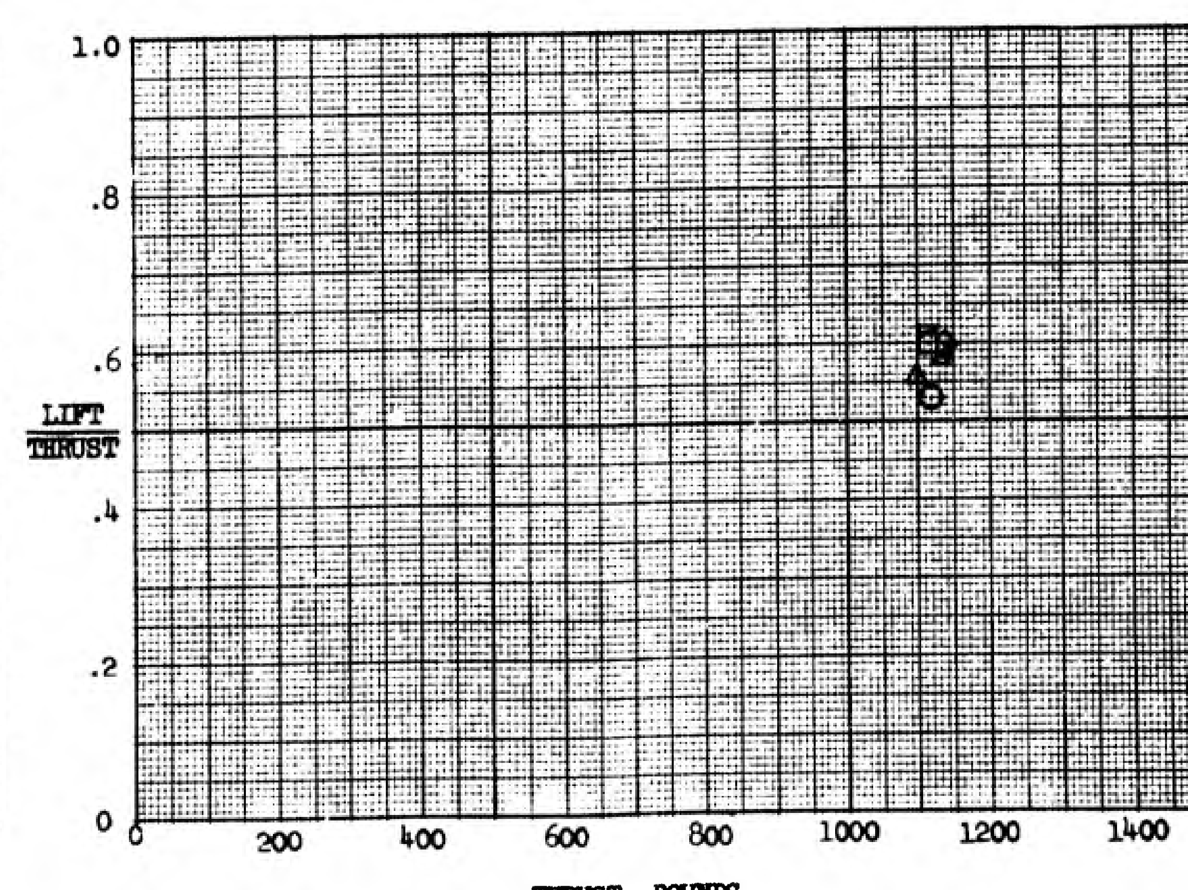


Figure 58

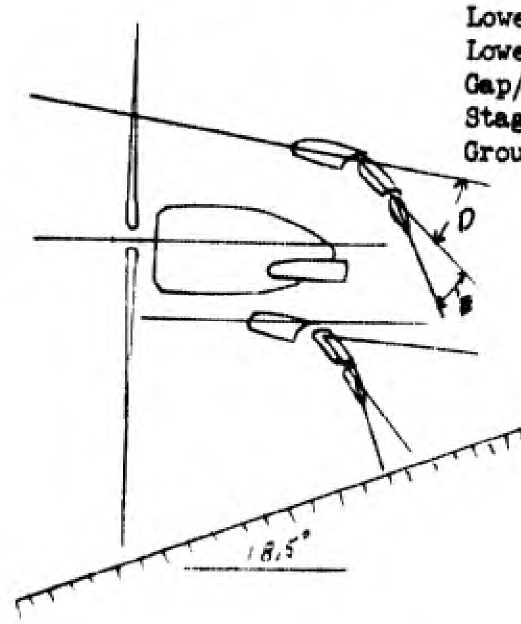
MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

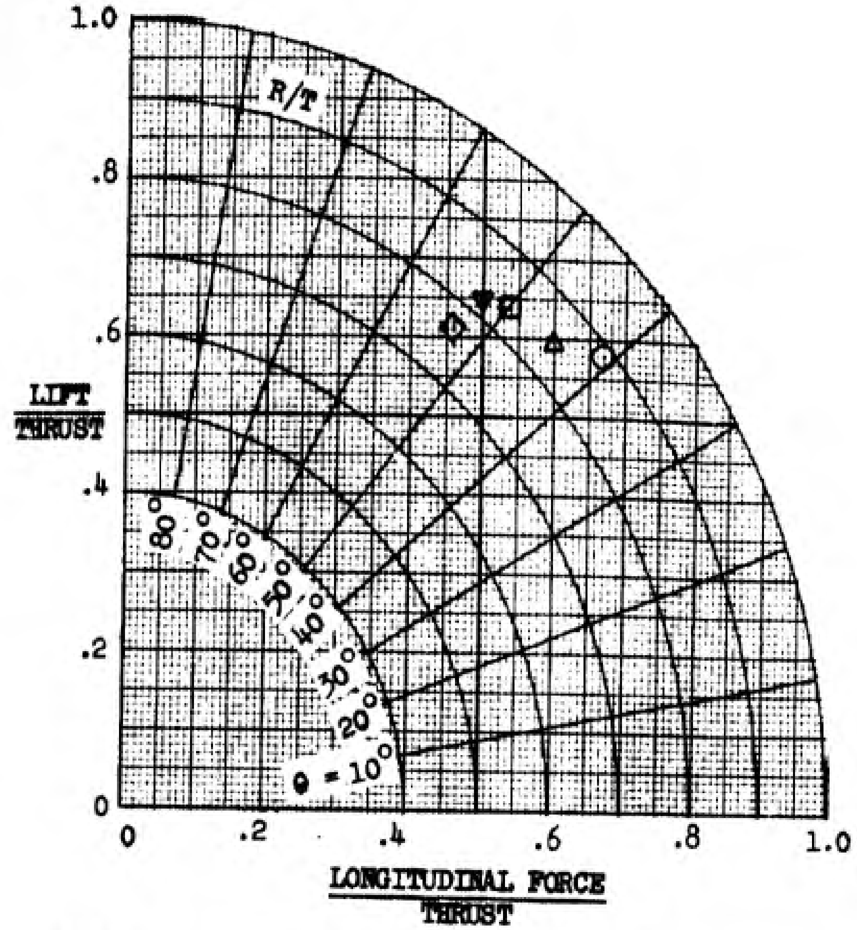
Effect of Upper Wing Flaps with Upper Wing at 20°

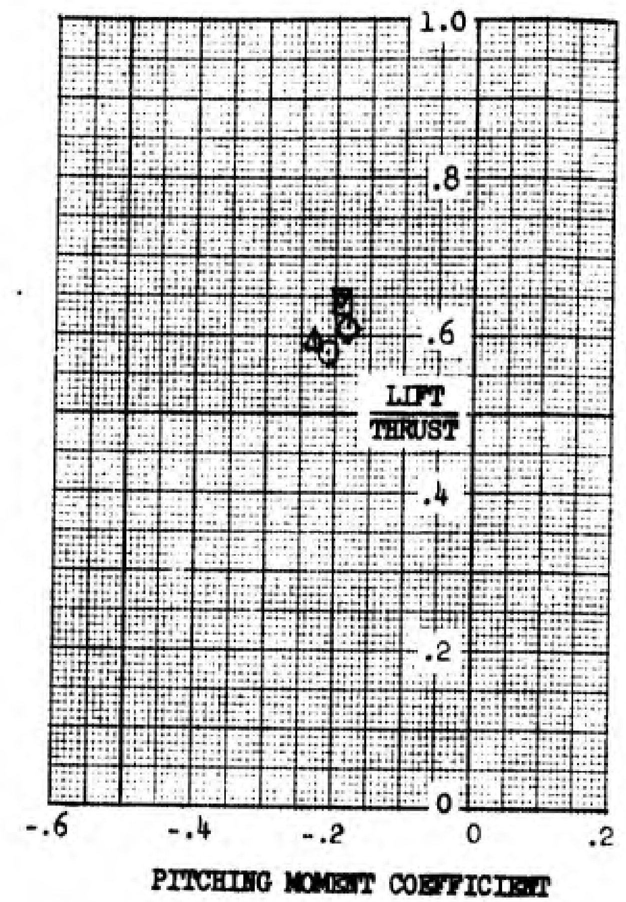
And Lower Wing at 5° Angle of Incidence

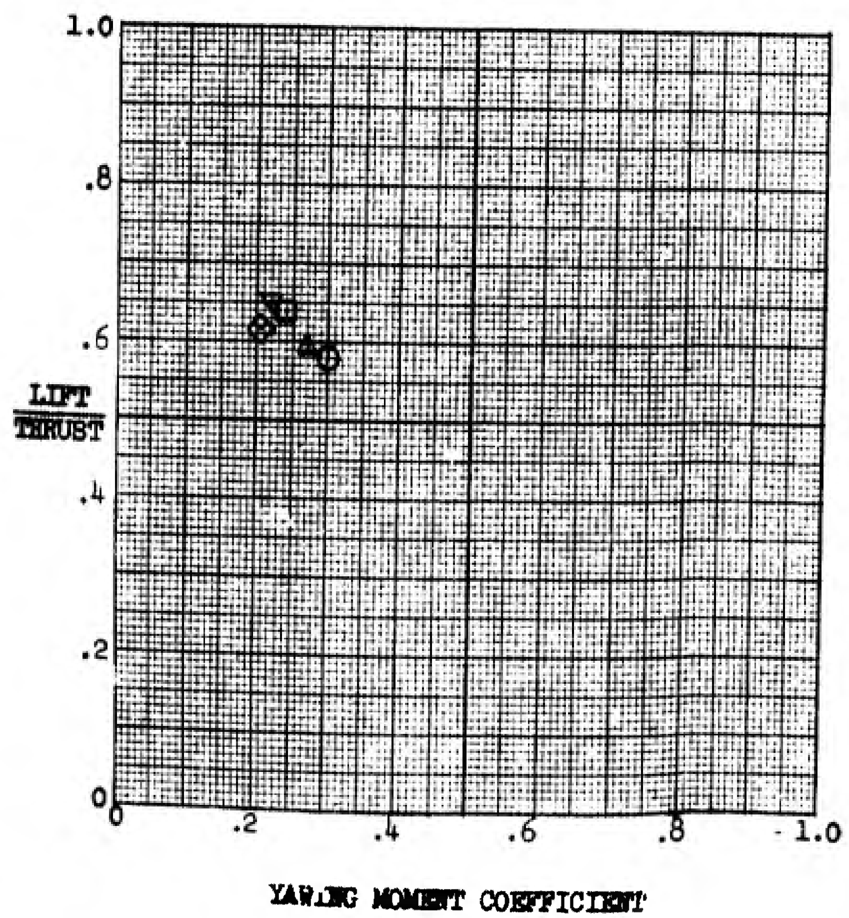
Lower wing forward flap = 50° deflection
Lower wing aft flap = 51° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

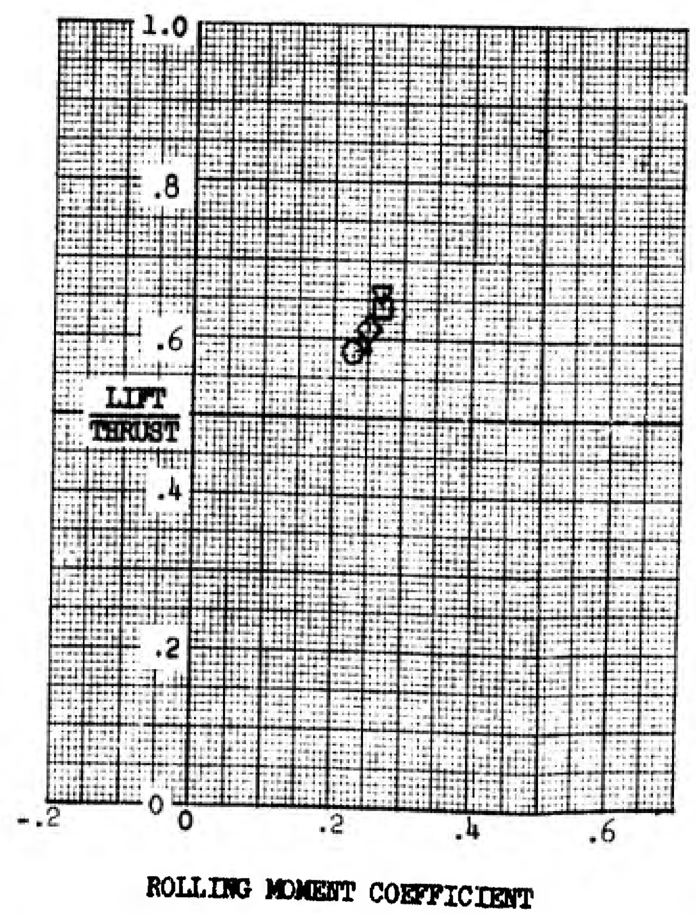


SYM	RUN	D	E
	B 4.1	25.00	14.50
	B 4.2	30.00	21.00
	B 4.3	35.00	29.00
	B 4.4	40.00	37.00
◇	B 4.5	45.00	44.00









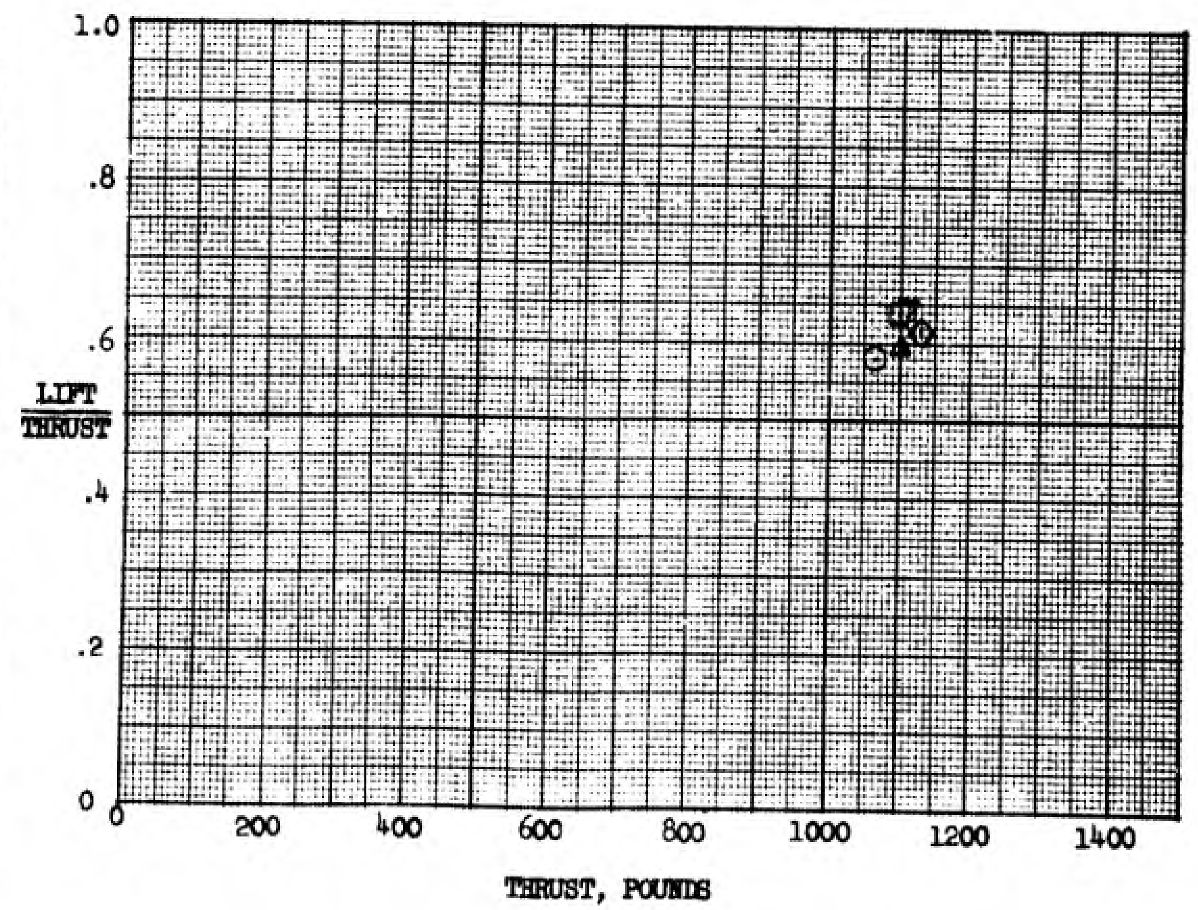


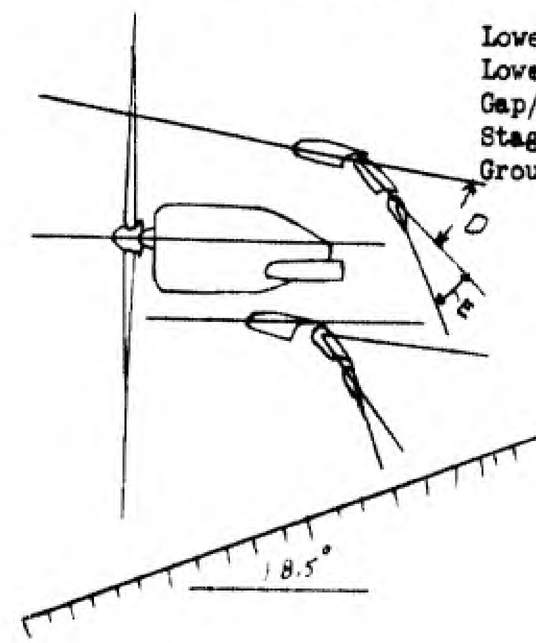
Figure 59

MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

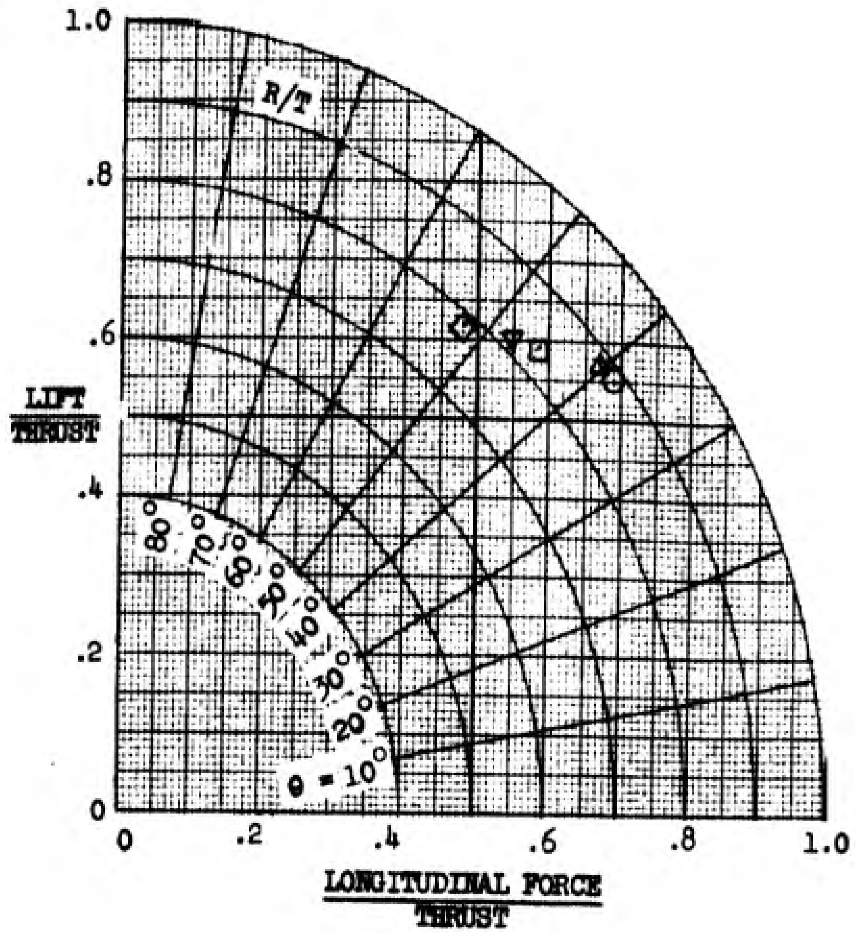
Effect of Upper Wing Flaps with Upper Wing at 15°

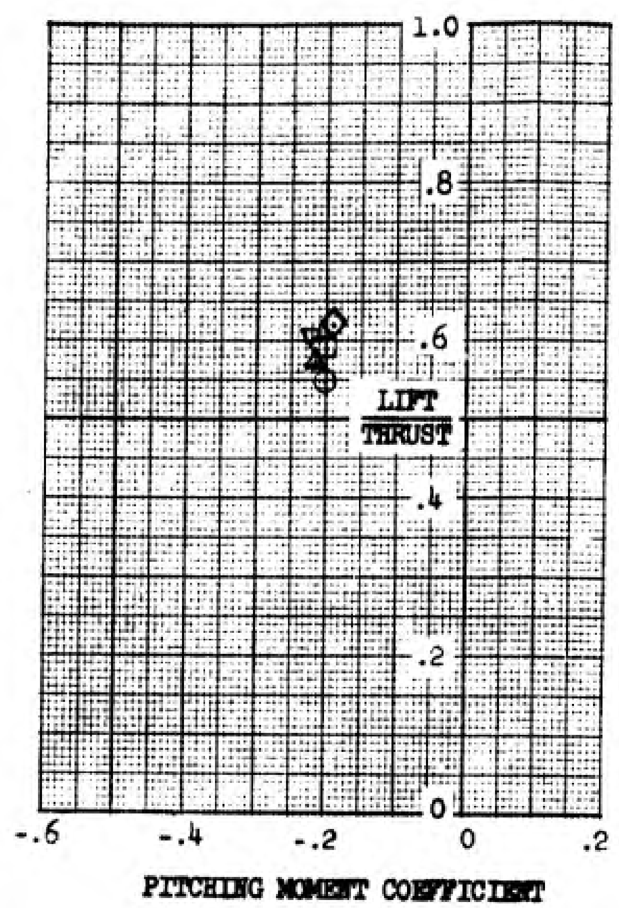
And Lower Wing at 5° Angle of Incidence

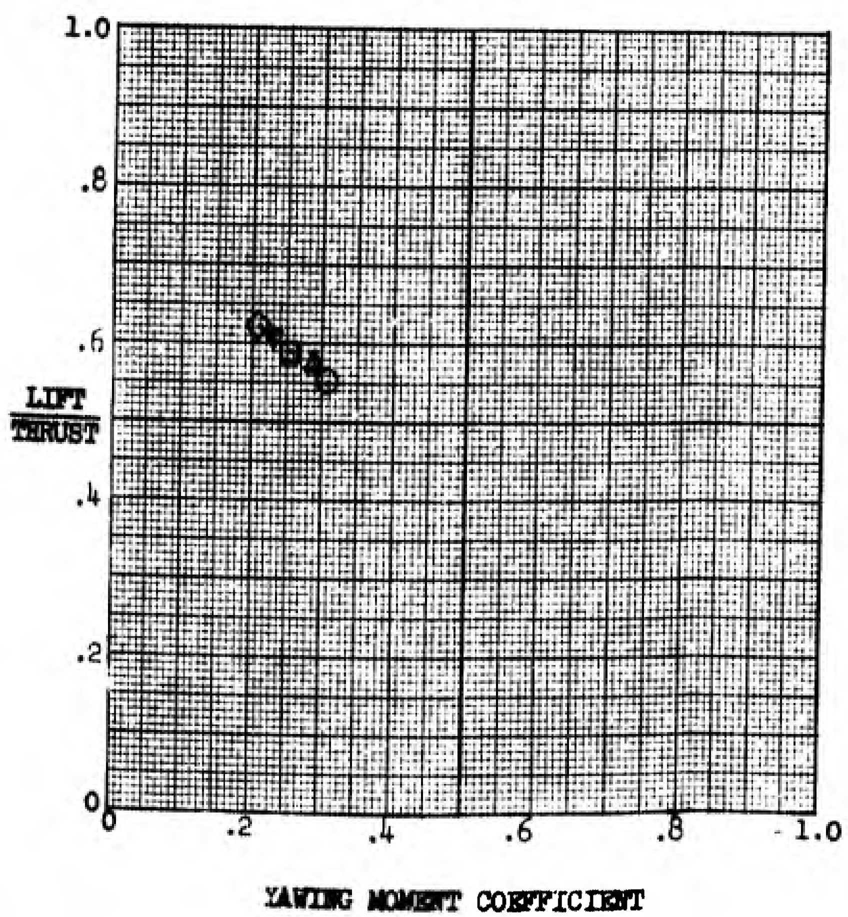


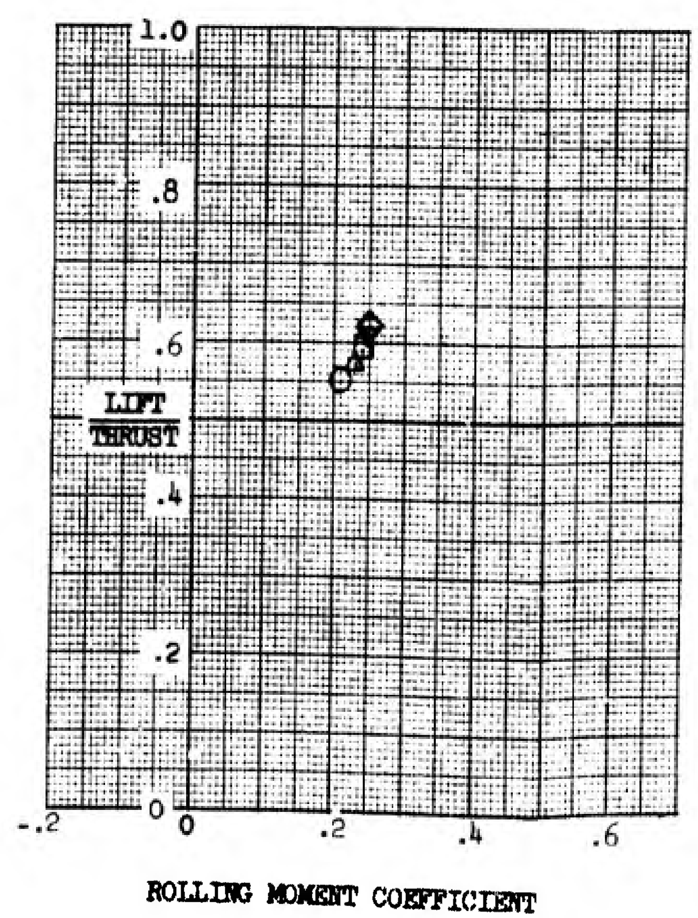
Lower wing forward flap = 50° deflection
Lower wing aft flap = 51° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

SYM	RUN	D	E
○	B 5.1	25.00	14.50
	B 5.2	30.00	21.50
□	B 5.3	35.00	29.00
▽	B 5.4	40.00	37.00
◇	B 5.5	45.00	44.00









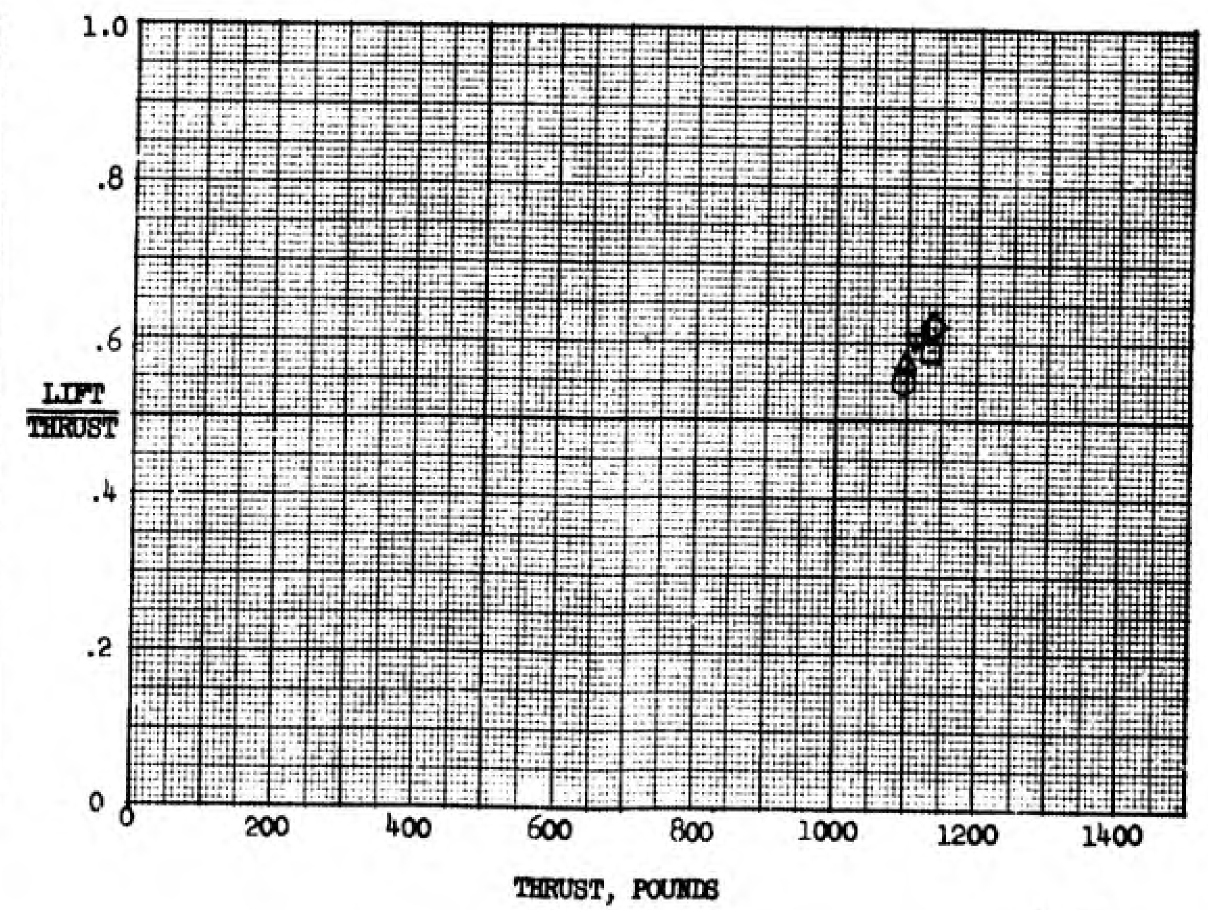


Figure 60

MODEL 88 BIPLANE CONFIGURATION

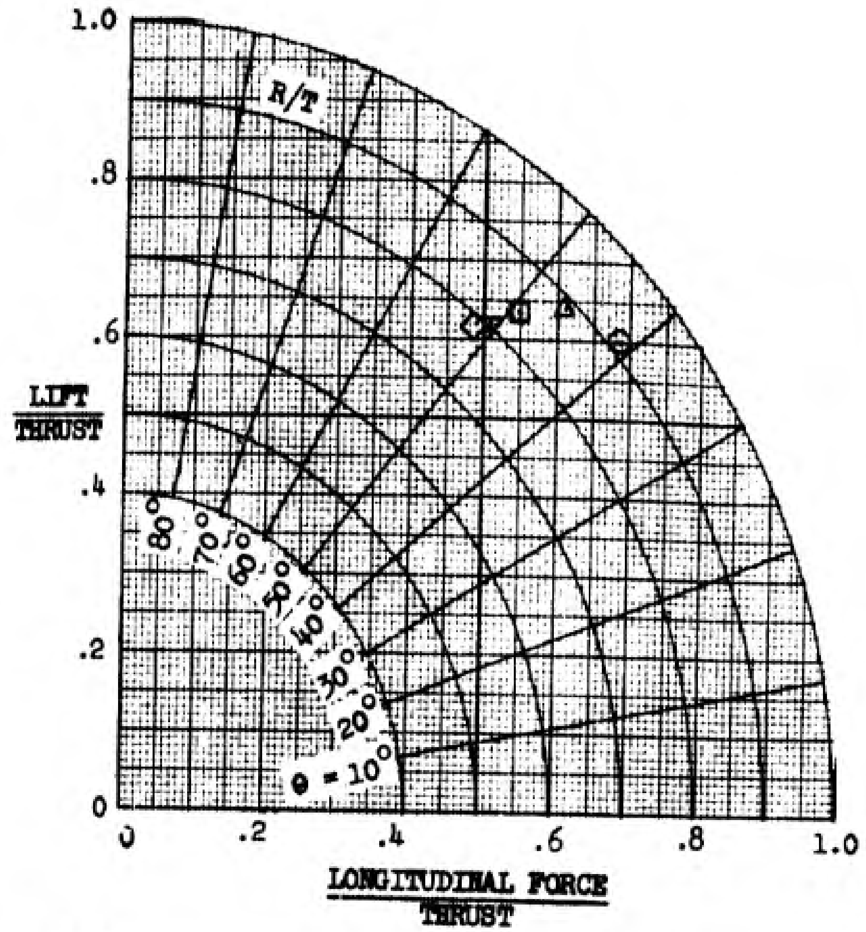
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

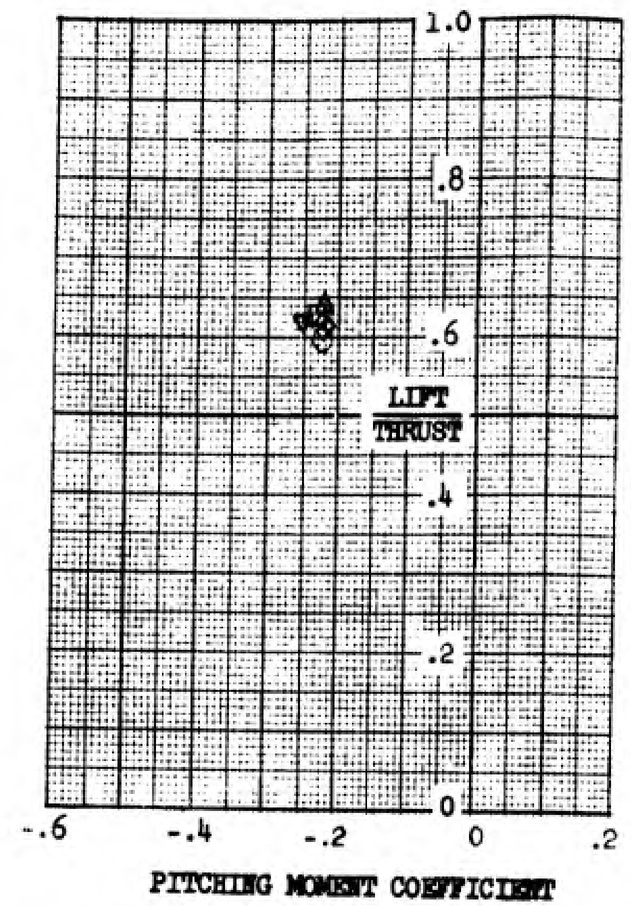
Effect of Upper Wing Flaps with Upper Wing at 20°

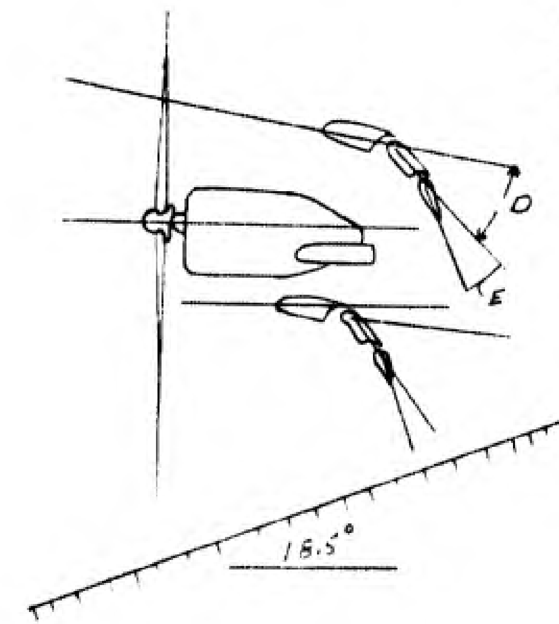
And Lower Wing at 5° Angle of Incidence

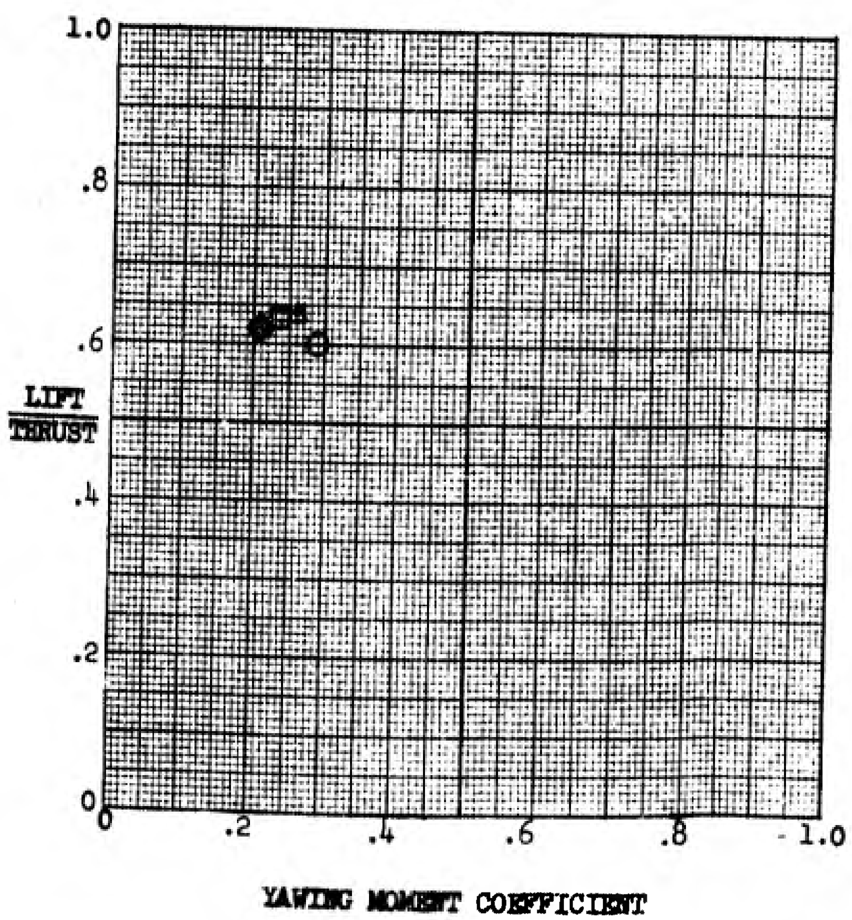
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.89
Stagger/chord ratio = -0.32
Ground plane installed

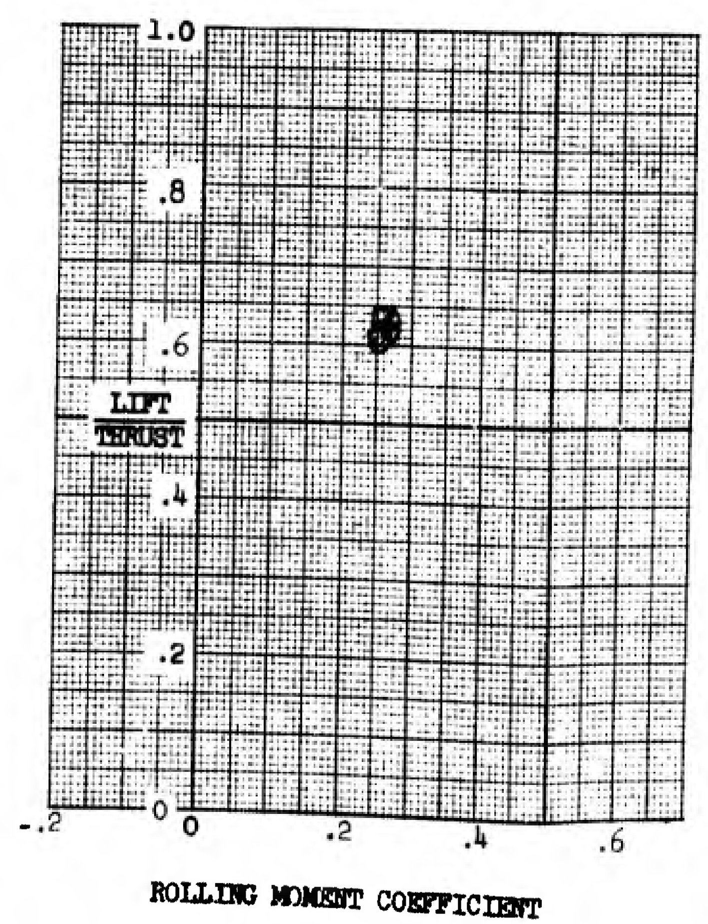
SYM	RUN	D	E
○	B 9.1	25.00	14.50
△	B 9.2	30.00	21.50
□	B 9.3	35.00	29.00
◁	B 9.4	40.00	37.00
◇	B 9.5	45.00	44.00











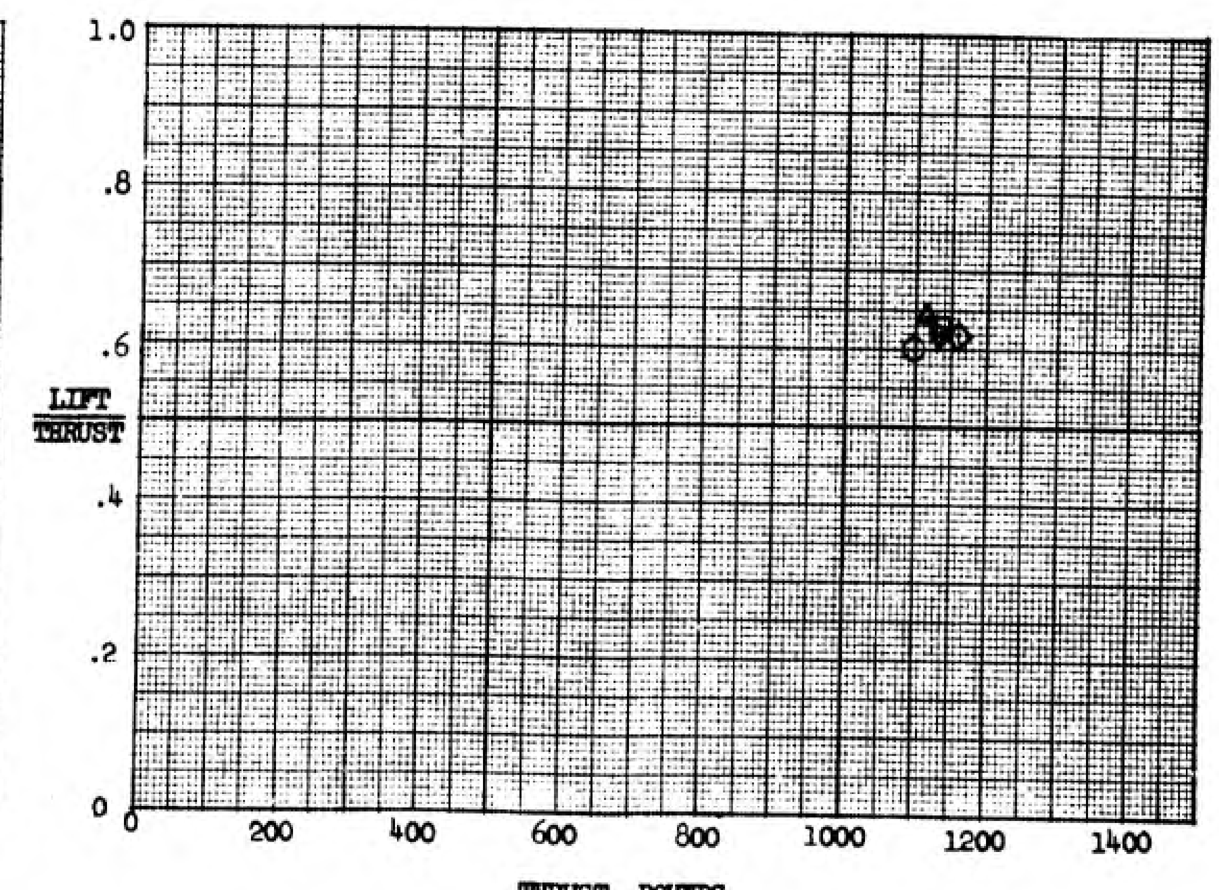


Figure 61

MODEL 88 BIPLANE CONFIGURATION

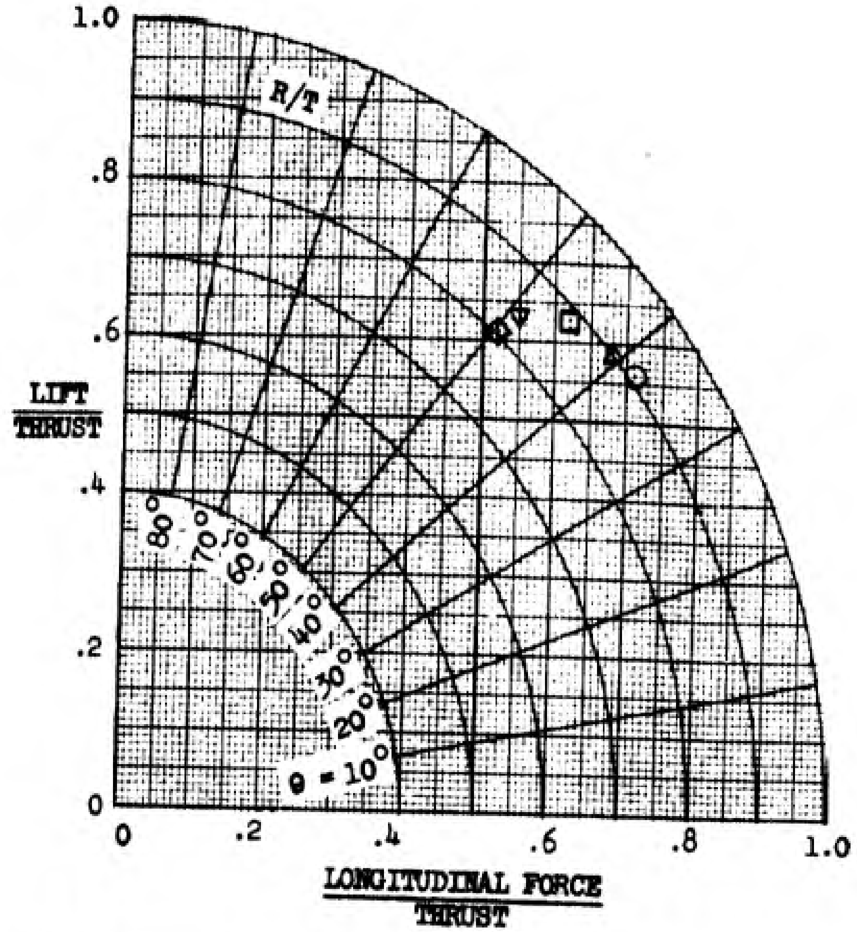
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

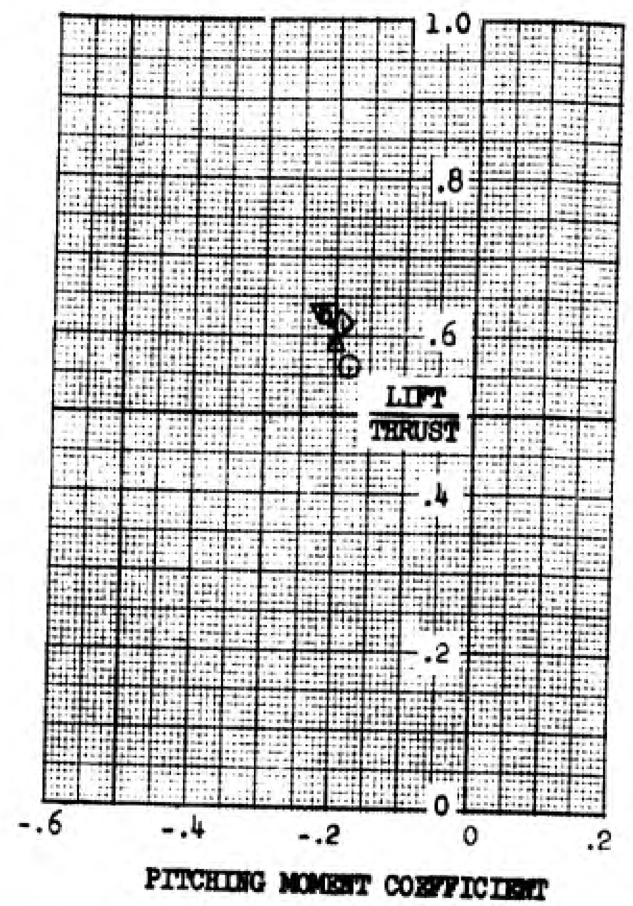
Effect of Upper Wing Flaps with Upper Wing at 15°

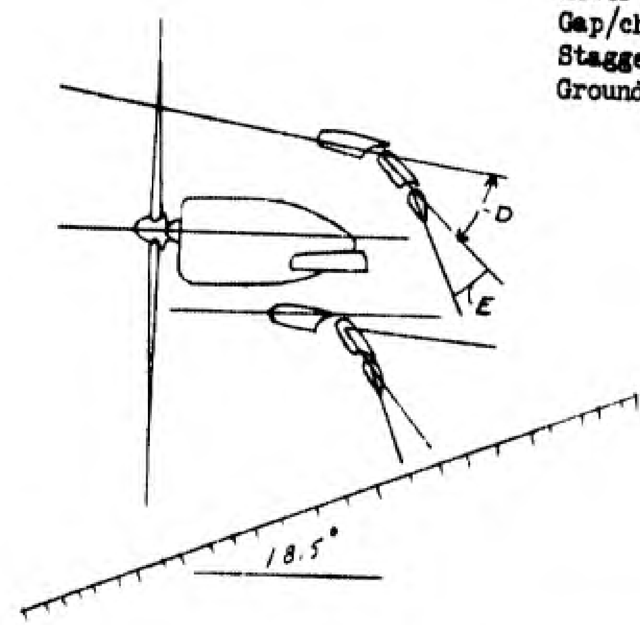
And Lower Wing at 5° Angle of Incidence

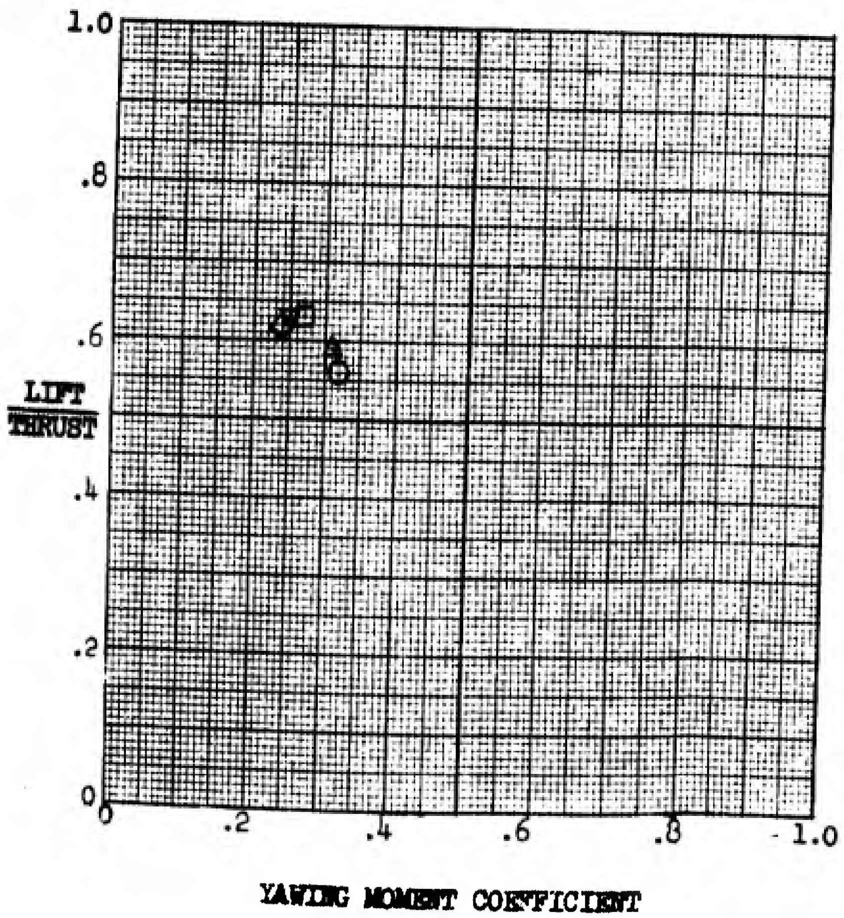
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.89
Stagger/chord ratio = -0.32
Ground plane installed

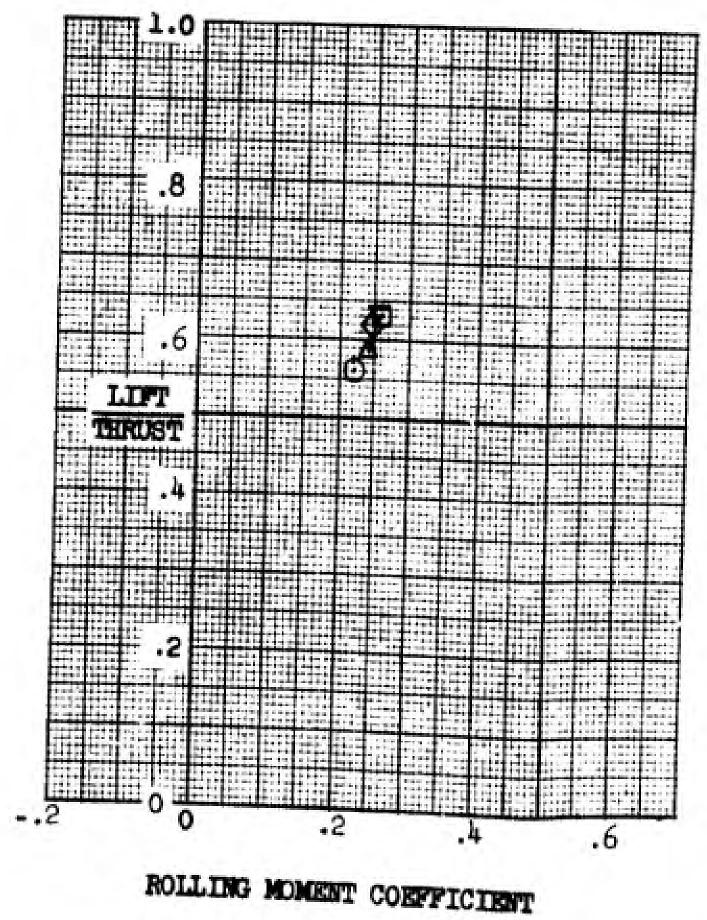
SYM	RUN	D	E
○	B 10.1	25.00	14.50
△	B 10.2	30.00	21.50
□	B 10.3	35.00	29.00
▽	B 10.4	40.00	37.00
◇	B 10.5	45.00	44.00

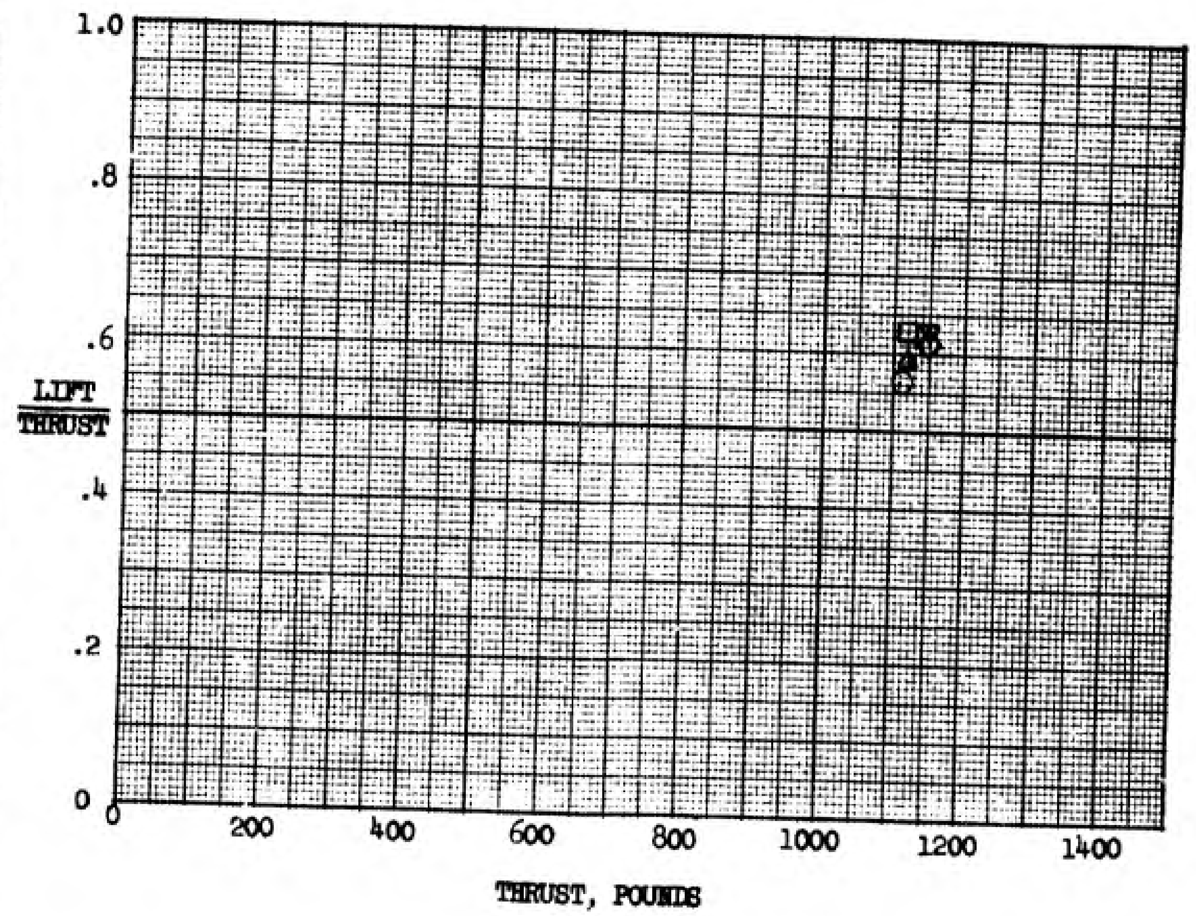












MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

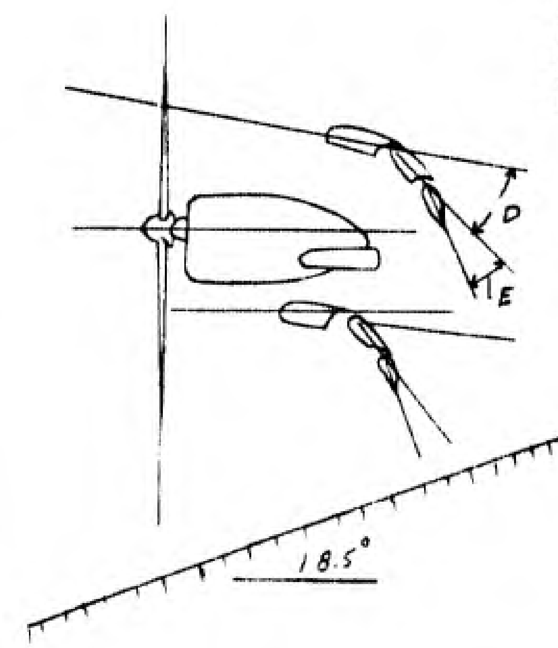
Effect of Upper Wing Flaps with Upper Wing at 25°

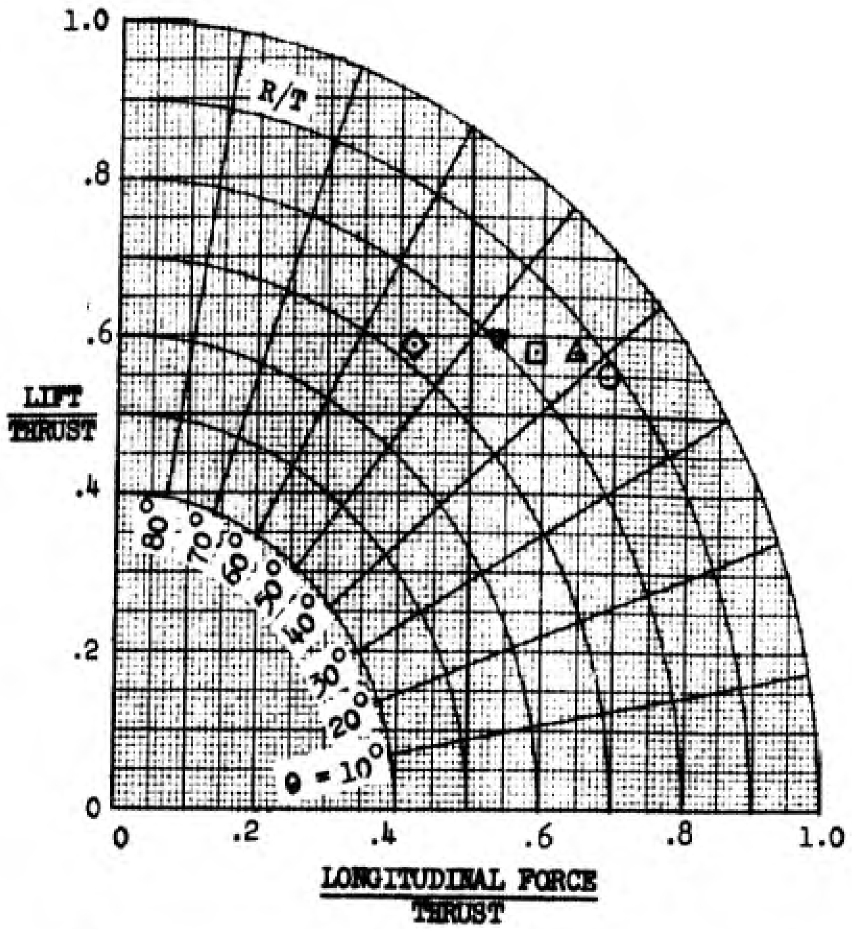
And Lower Wing at 5° Angle of Incidence

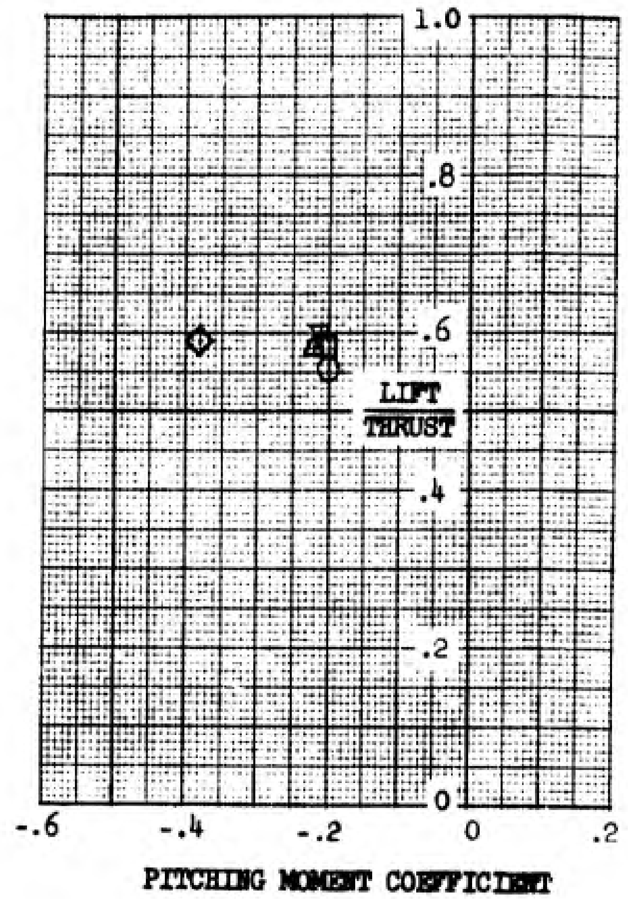
Figure 62

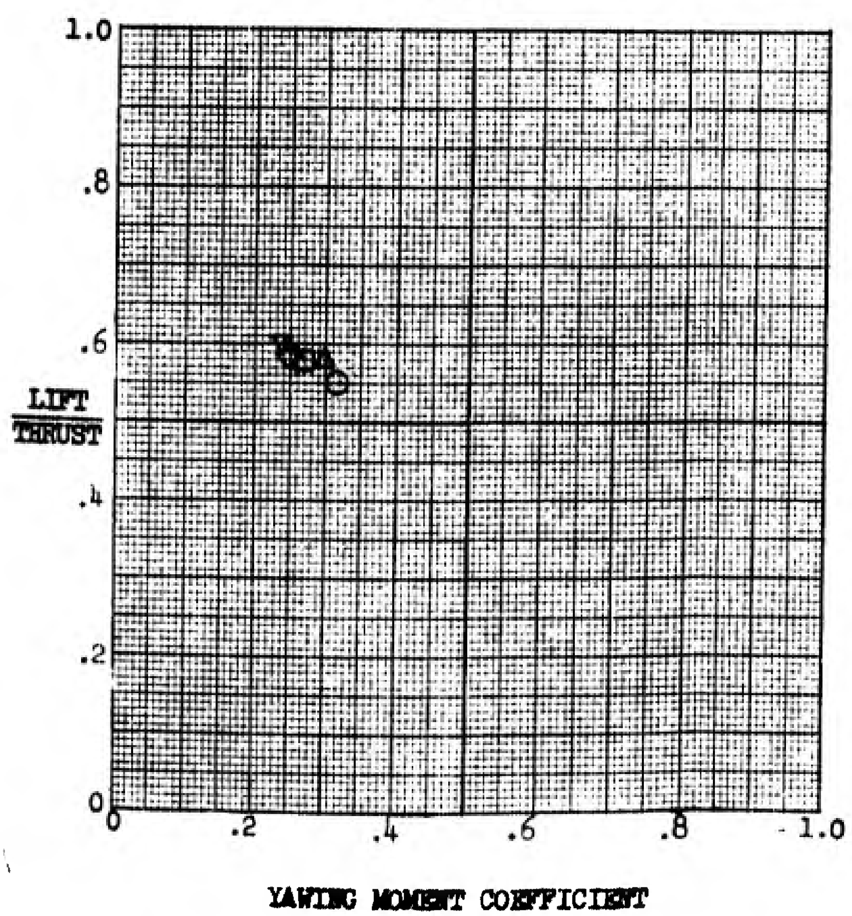
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.89
Stagger/chord ratio = -0.33
Ground plane installed

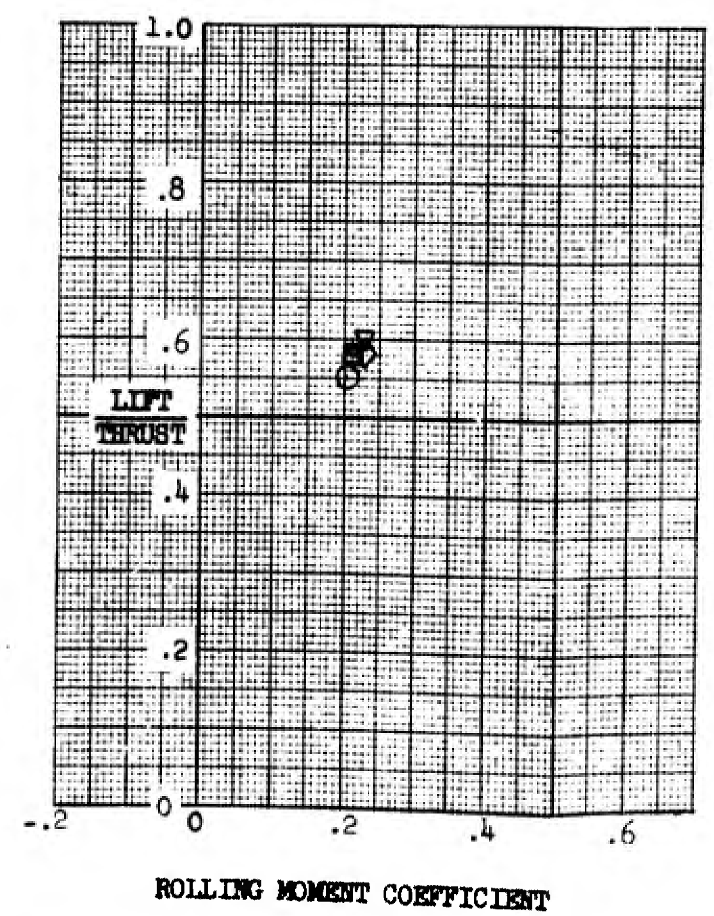
SYM	RUN	D	E
	B 11.1	20.00	8.00
	B 11.2	25.00	14.50
	B 11.3	30.00	21.50
	B 11.4	35.00	29.00
	B 11.5	40.00	37.00











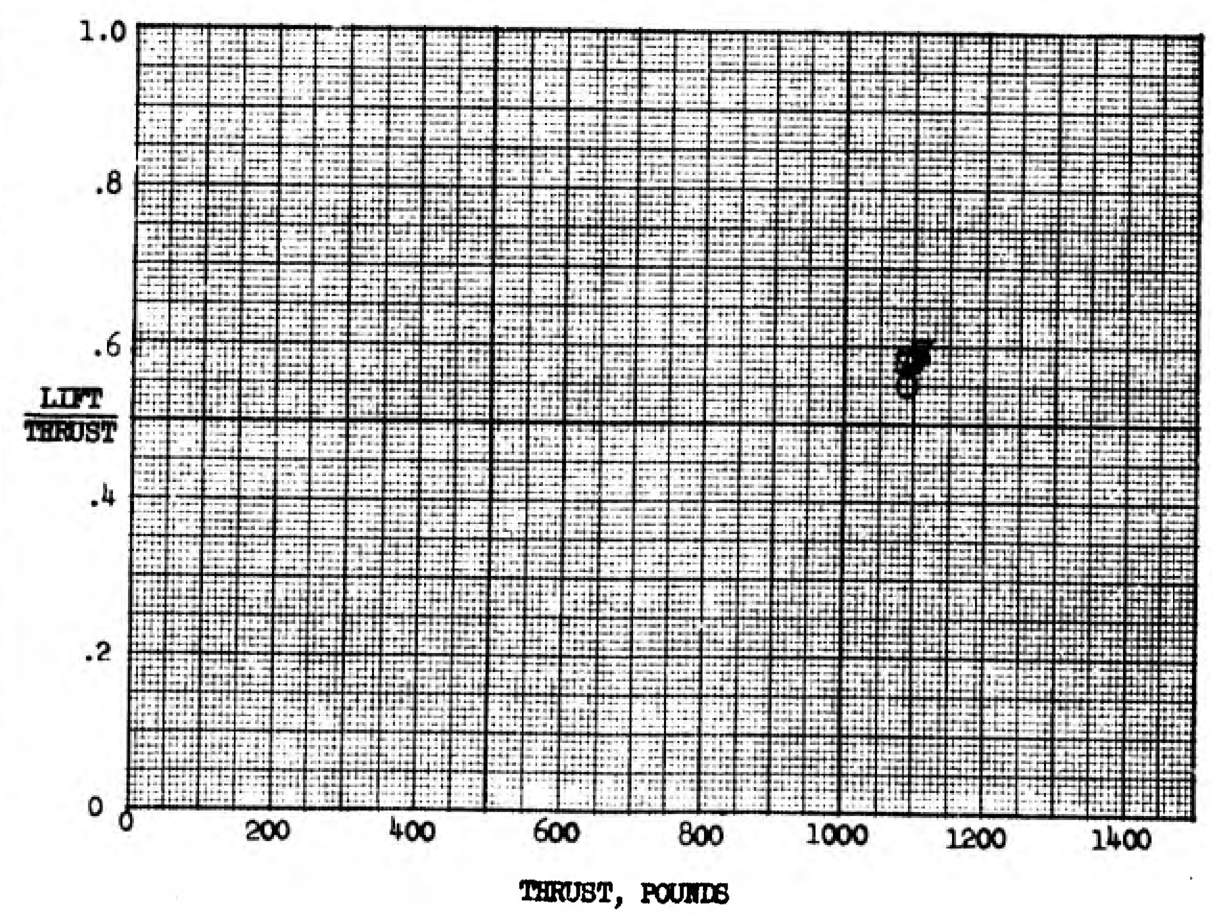


Figure 63

MODEL 88 BIPLANE CONFIGURATION

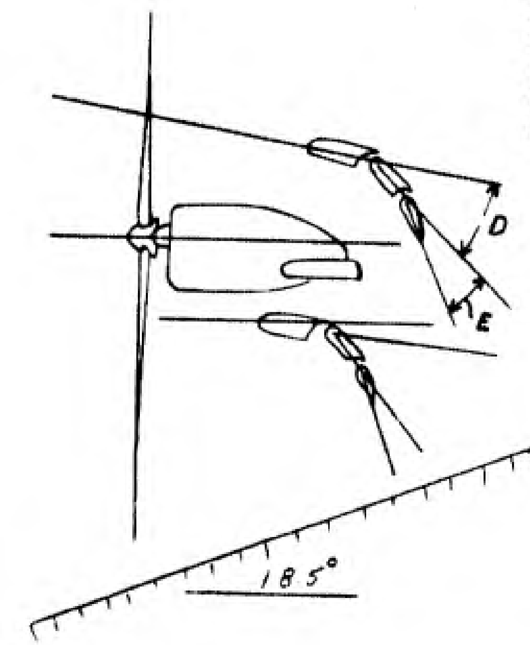
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

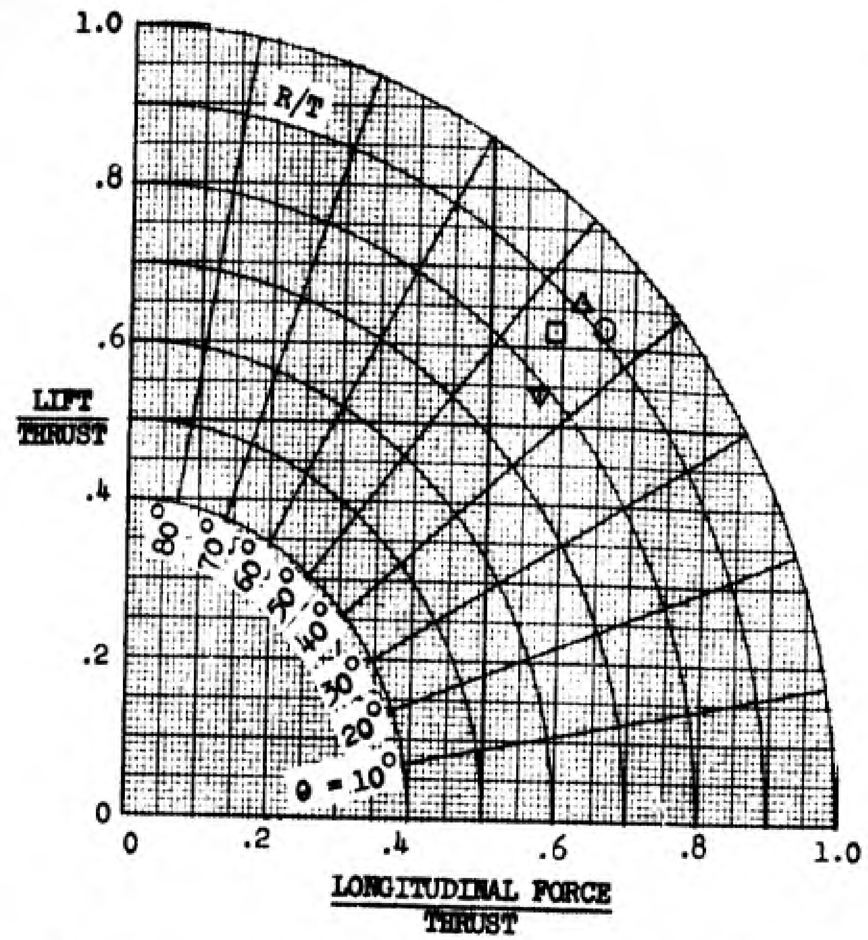
Effect of Upper Wing Flaps with Upper Wing at 20°

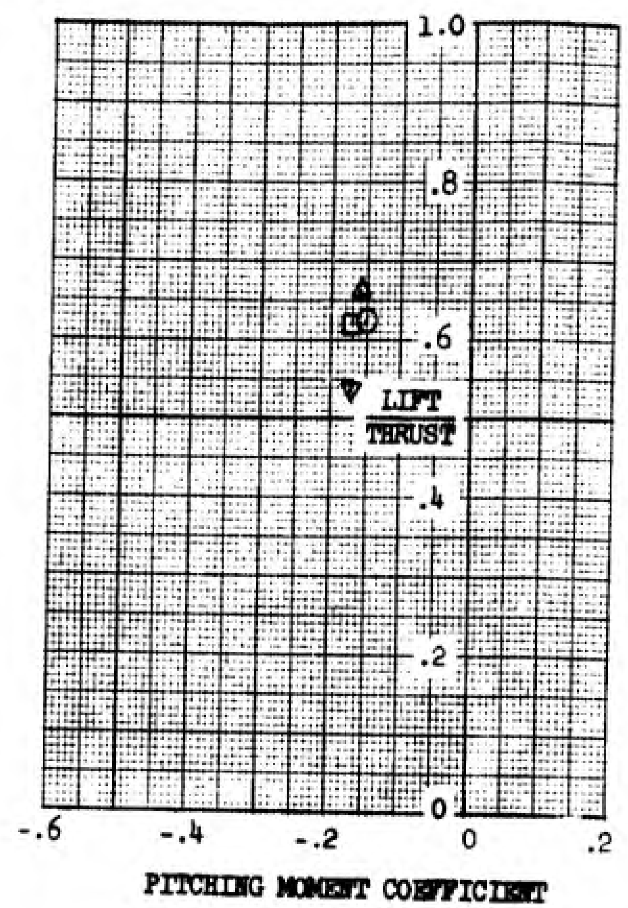
And Lower Wing at 5° Angle of Incidence

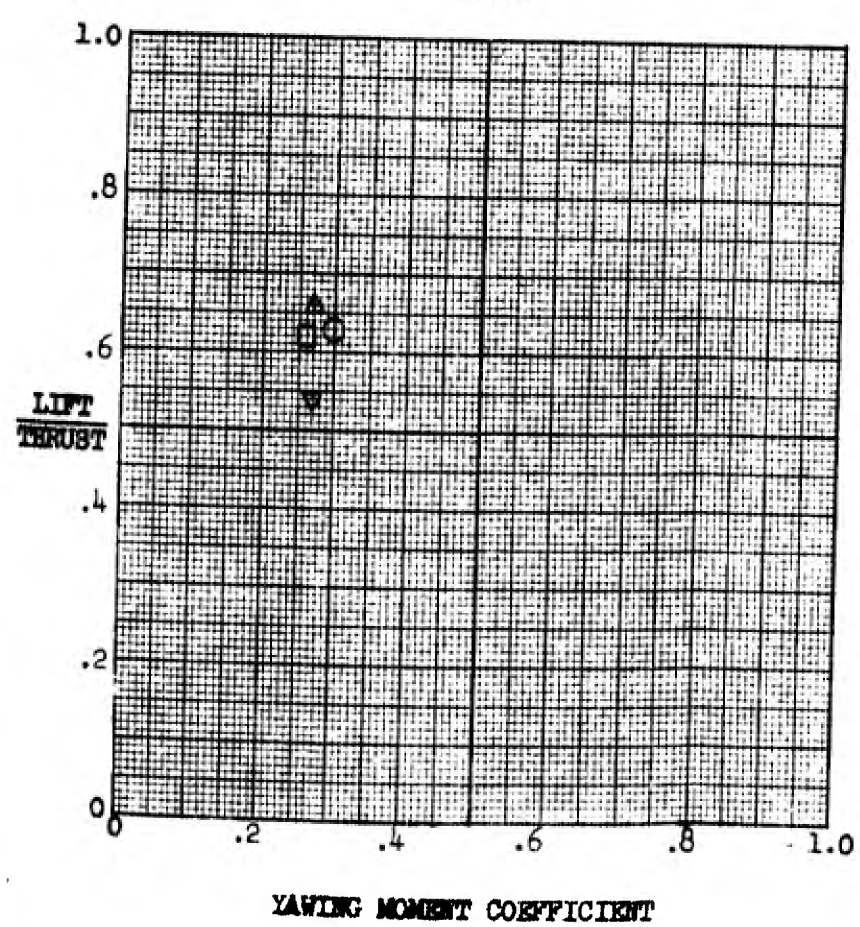
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.70
Stagger/chord ratio = -0.31
Ground plane installed

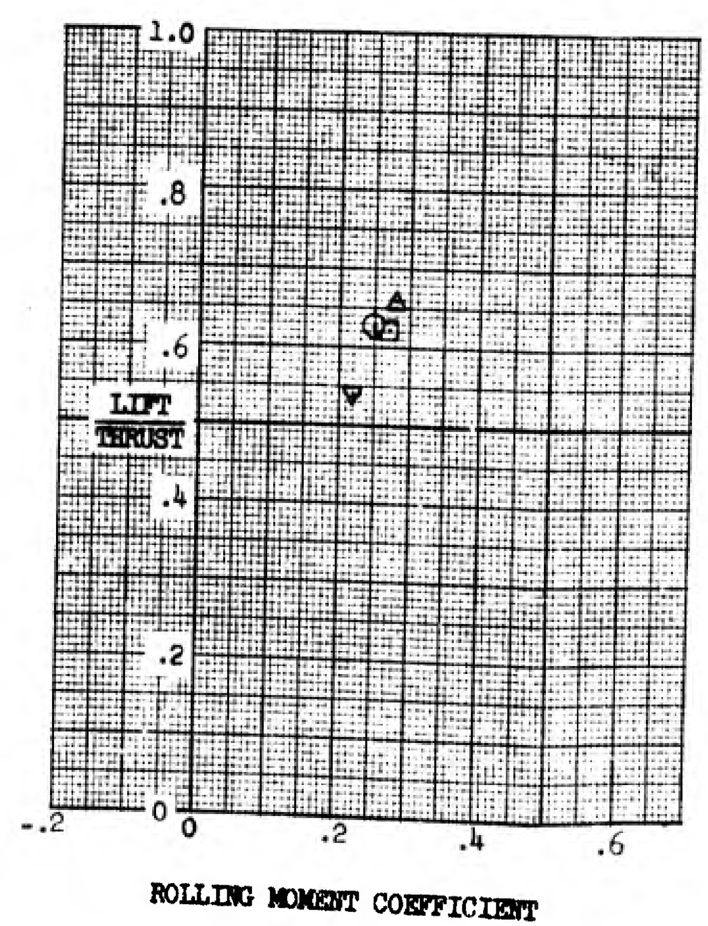
SYM	RUN	D	E
○	B 12.1	30.00	21.50
△	B 12.2	35.00	29.00
□	B 12.3	40.00	37.00
▽	B 12.4	45.00	44.00











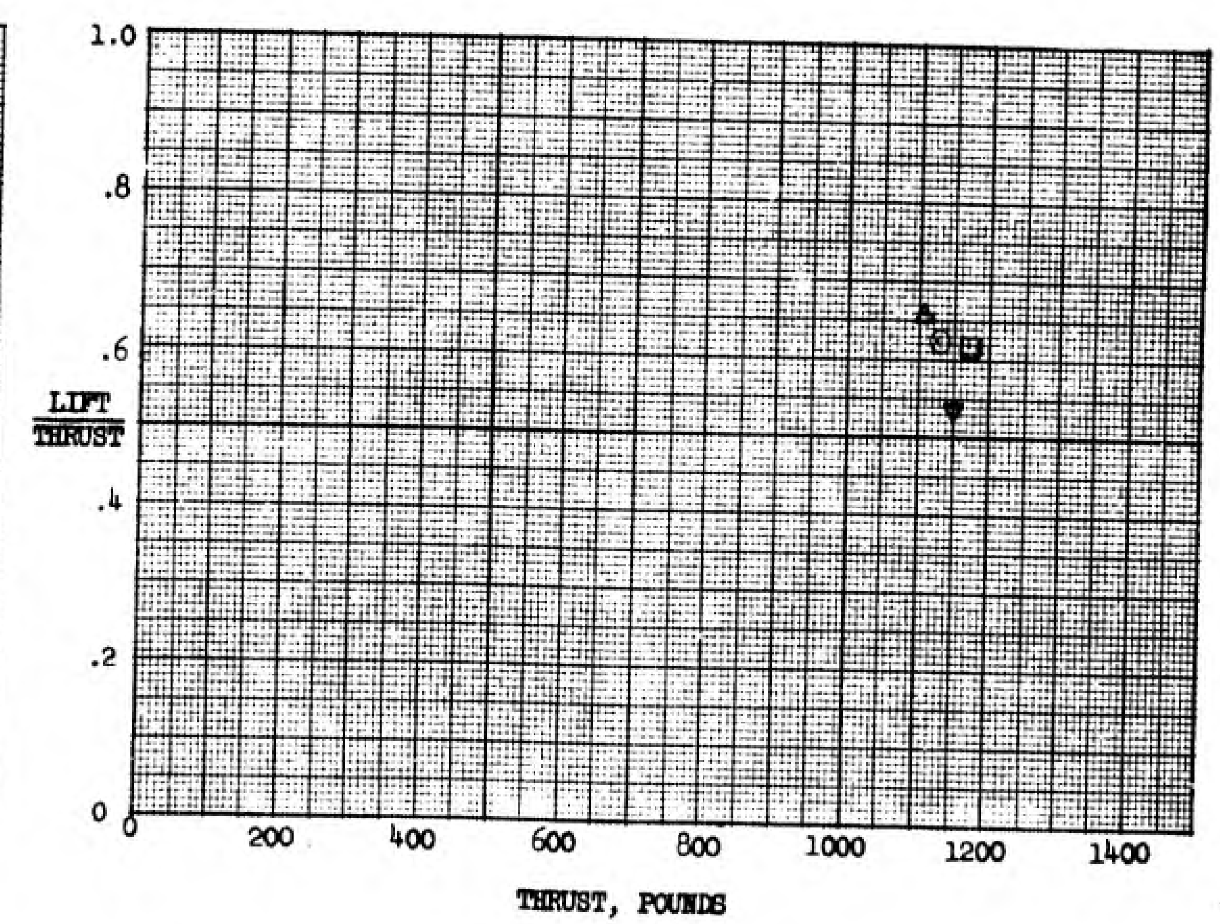


Figure 64

MODEL 88 BIPLANE CONFIGURATION

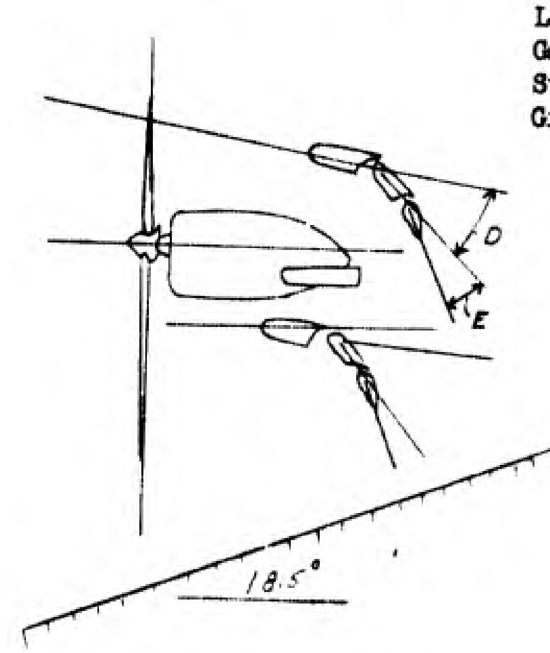
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

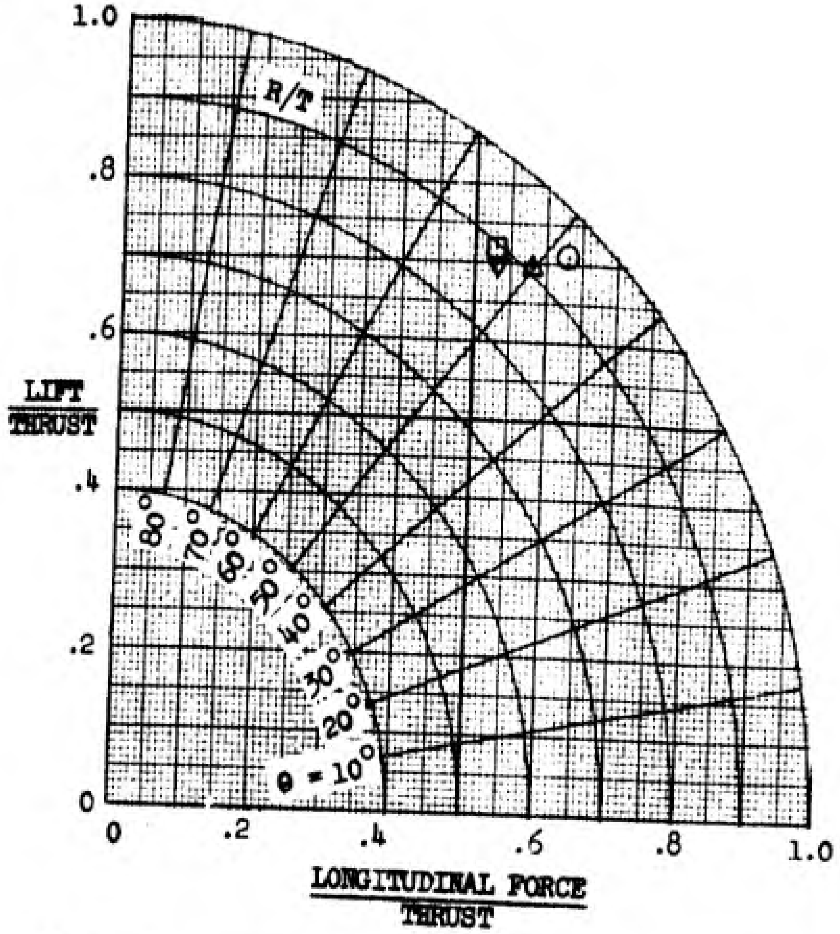
Effect of Upper Wing Flaps with Upper Wing at 20°

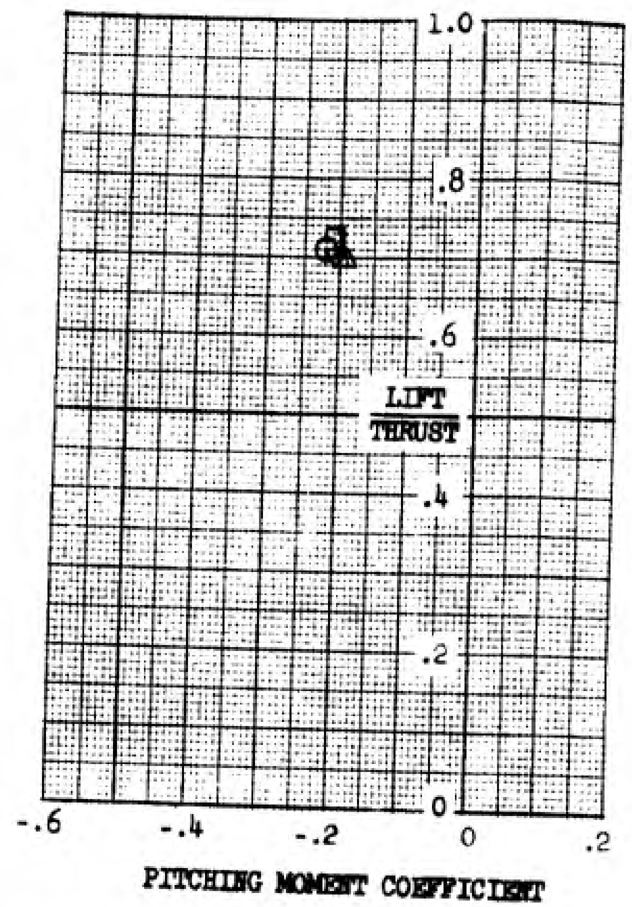
And Lower Wing at 5° Angle of Incidence

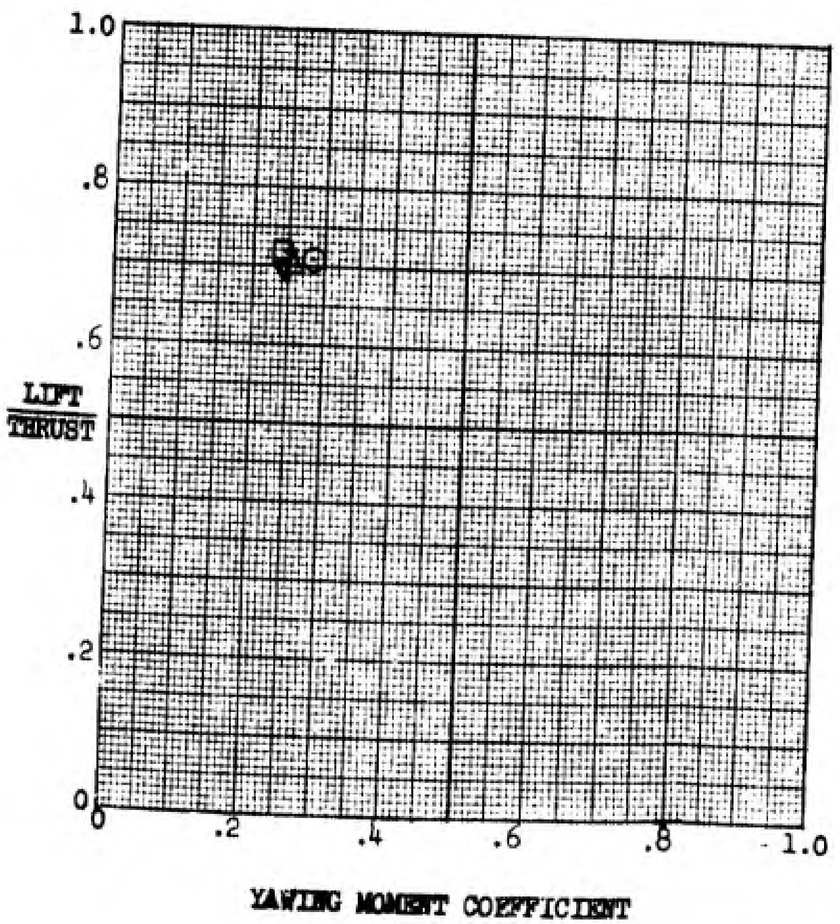
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.70
Stagger/chord ratio = -0.66
Ground plane installed

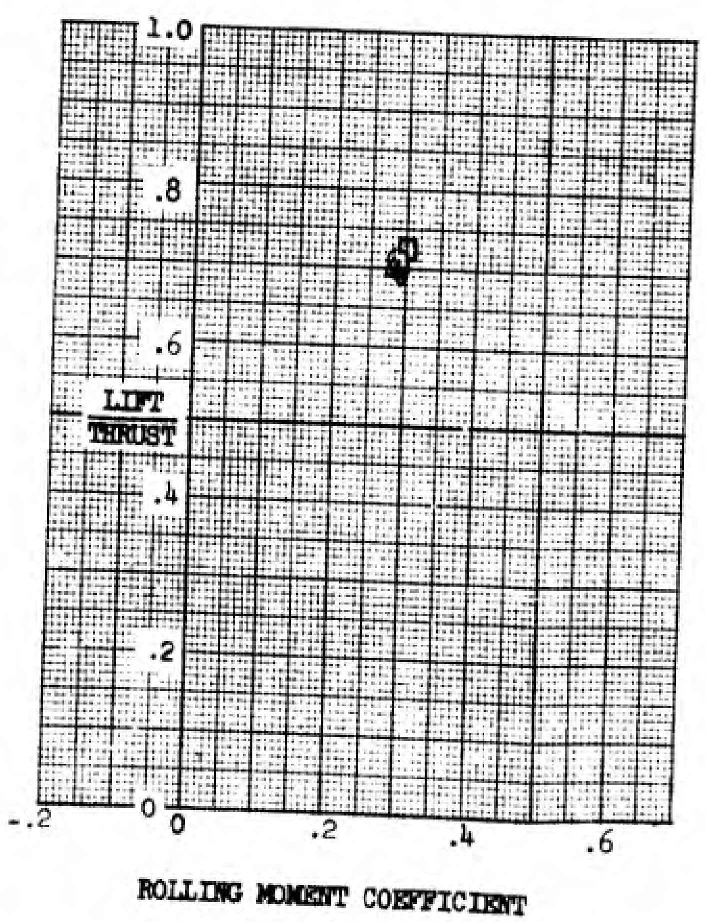
SYM	RUN	D	E
○	B 13.1	30.00	21.50
△	B 13.2	35.00	29.00
□	B 13.3	40.00	37.00
▽	B 13.4	45.00	44.00

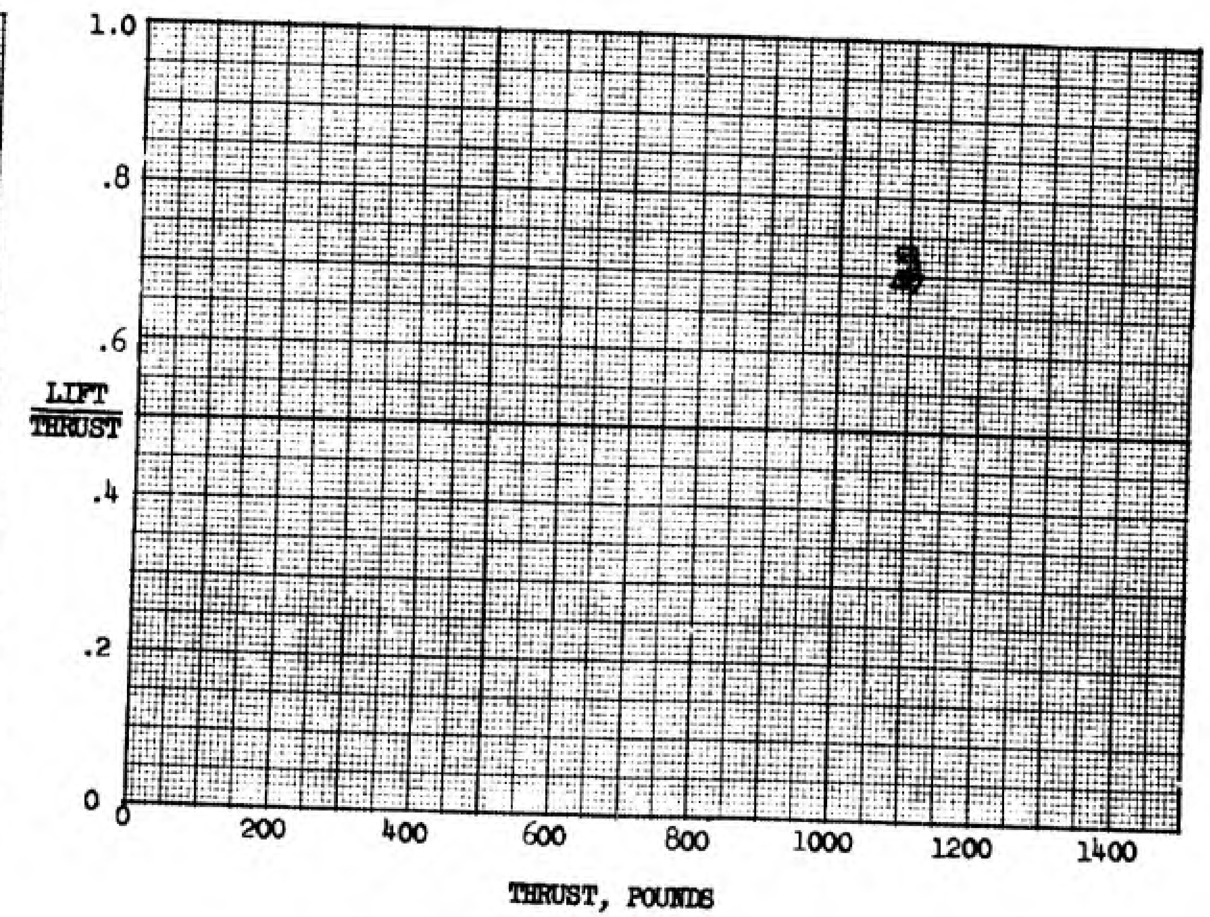












MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

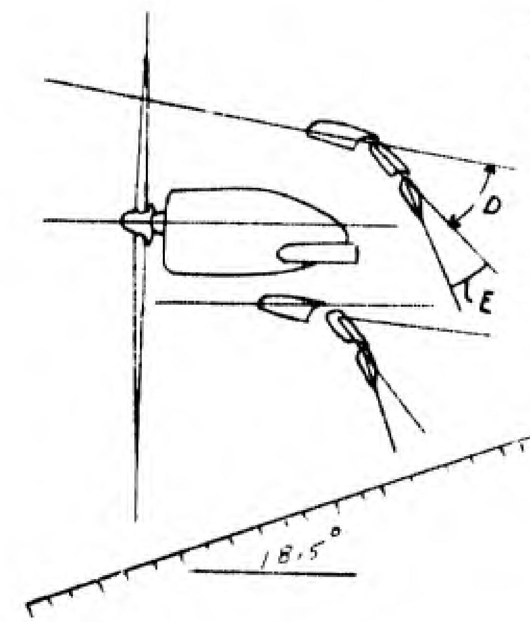
Effect of Upper Wing Flaps with Upper Wing at 20°

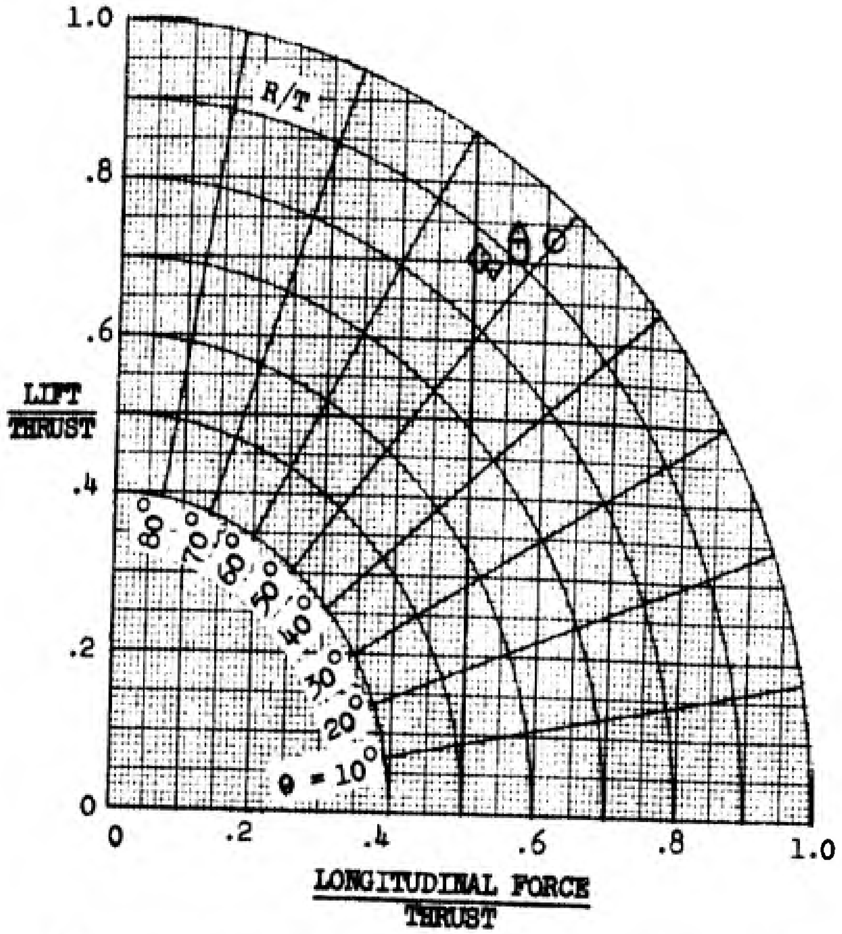
And Lower Wing at 5° Angle of Incidence

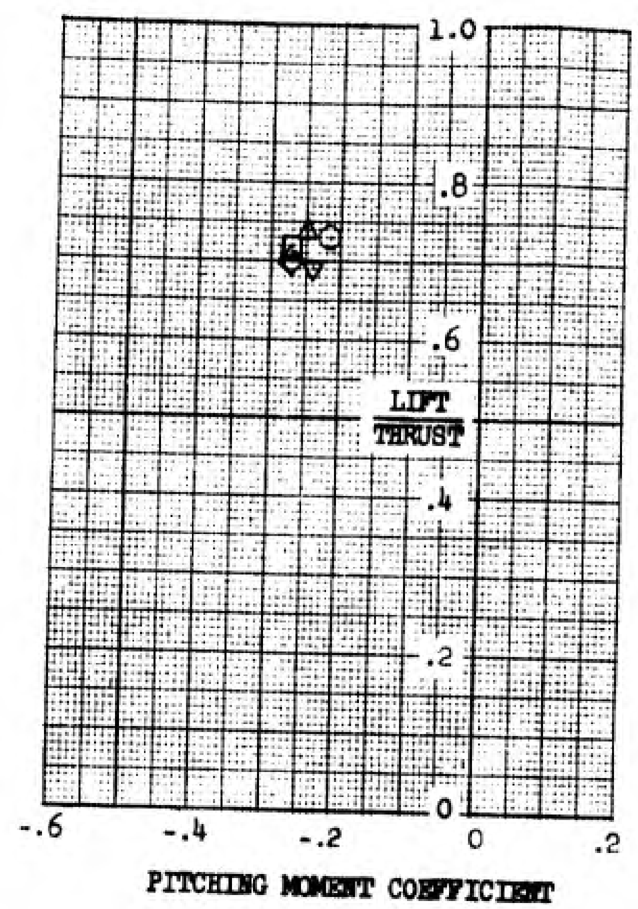
Figure 65

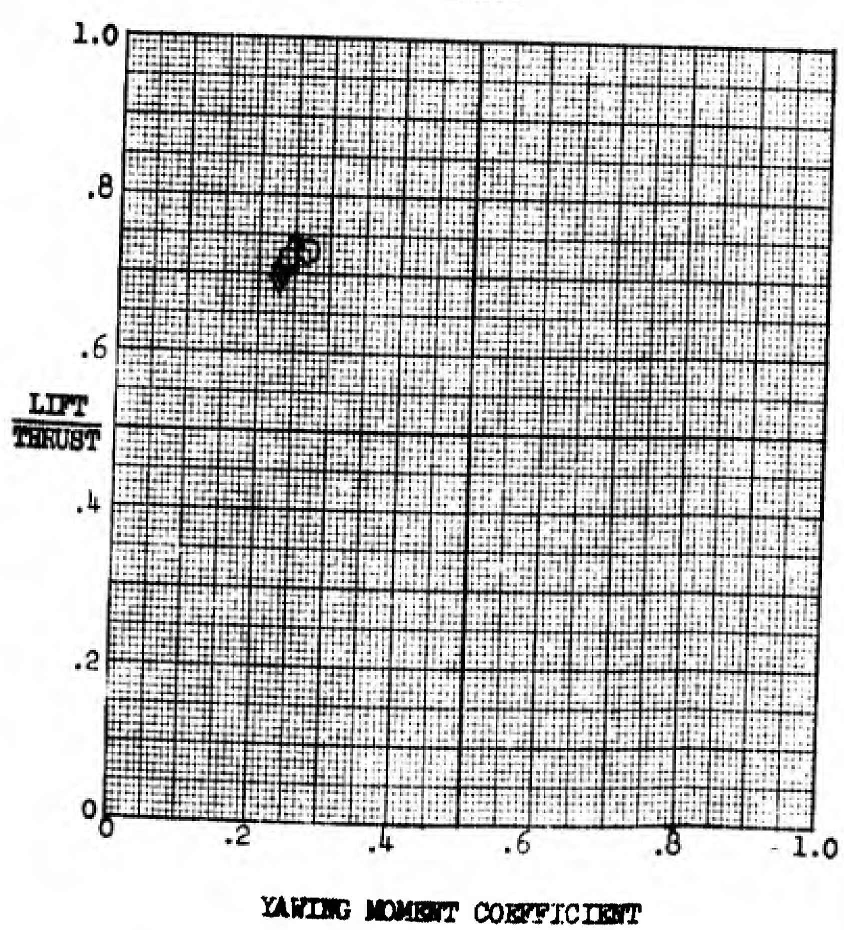
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -0.945
Ground plane installed

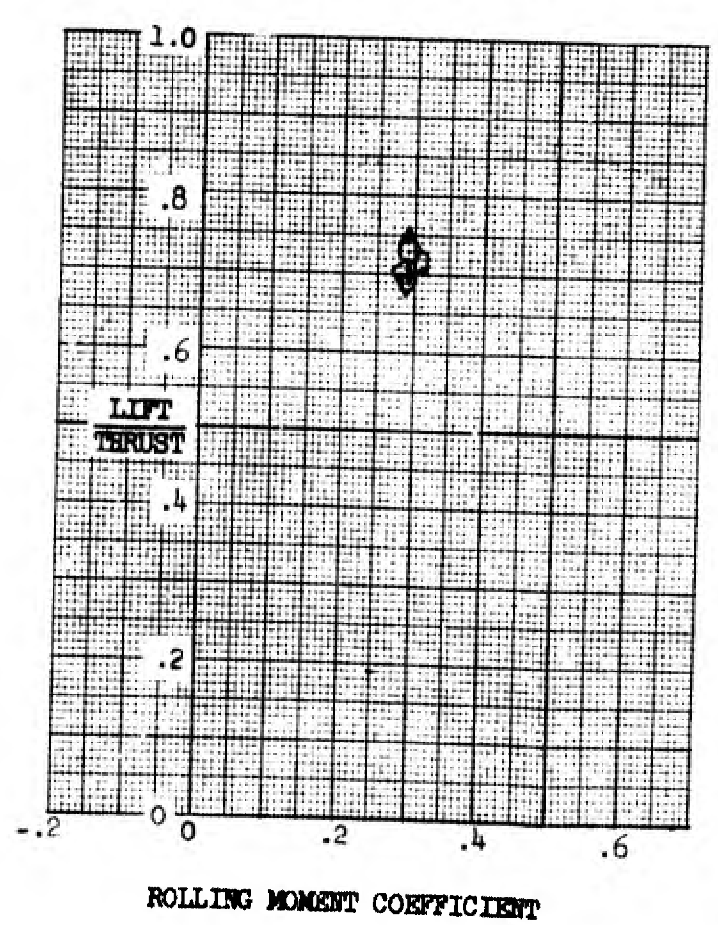
SYM	RUN	D	E
○	B 14.1	30.00	21.50
△	B 14.2	35.00	29.00
□	B 14.3	40.00	37.00
▽	B 14.4	45.00	44.00
◇	B 14.5	40.00	37.00











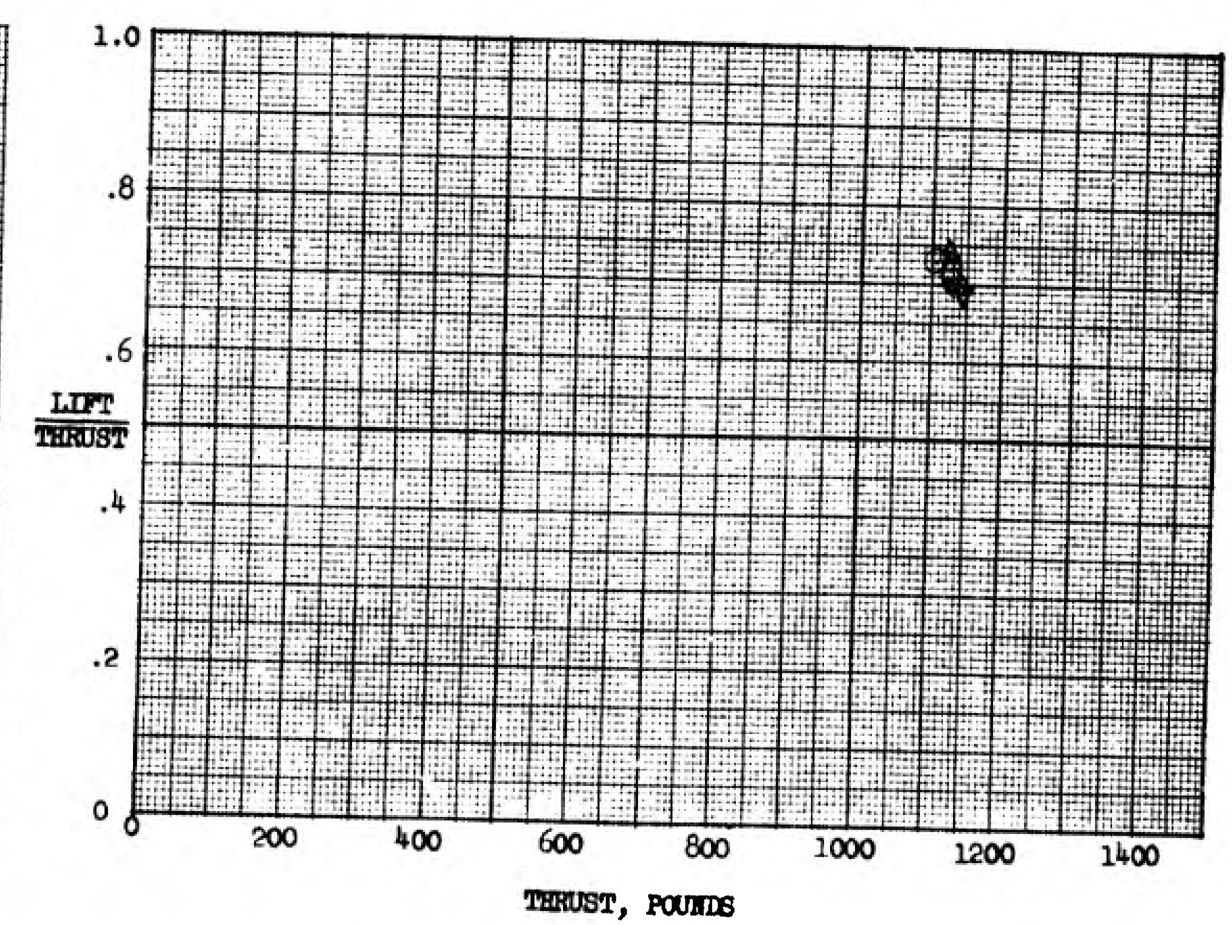


Figure 66

MODEL 88 BIPLANE CONFIGURATION

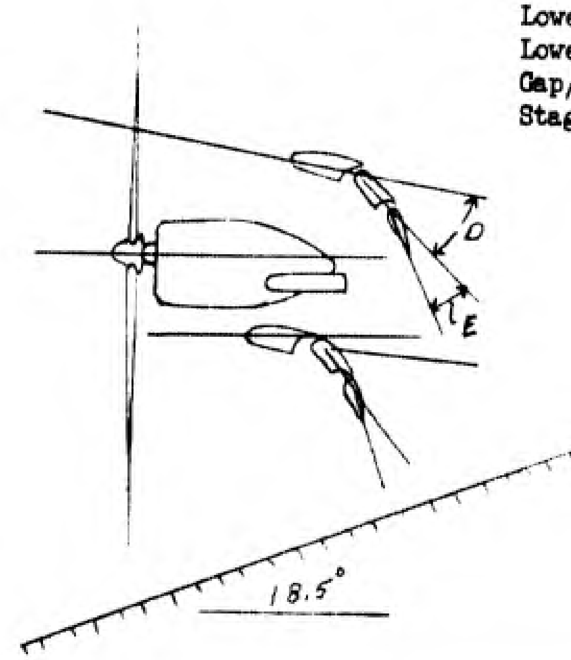
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

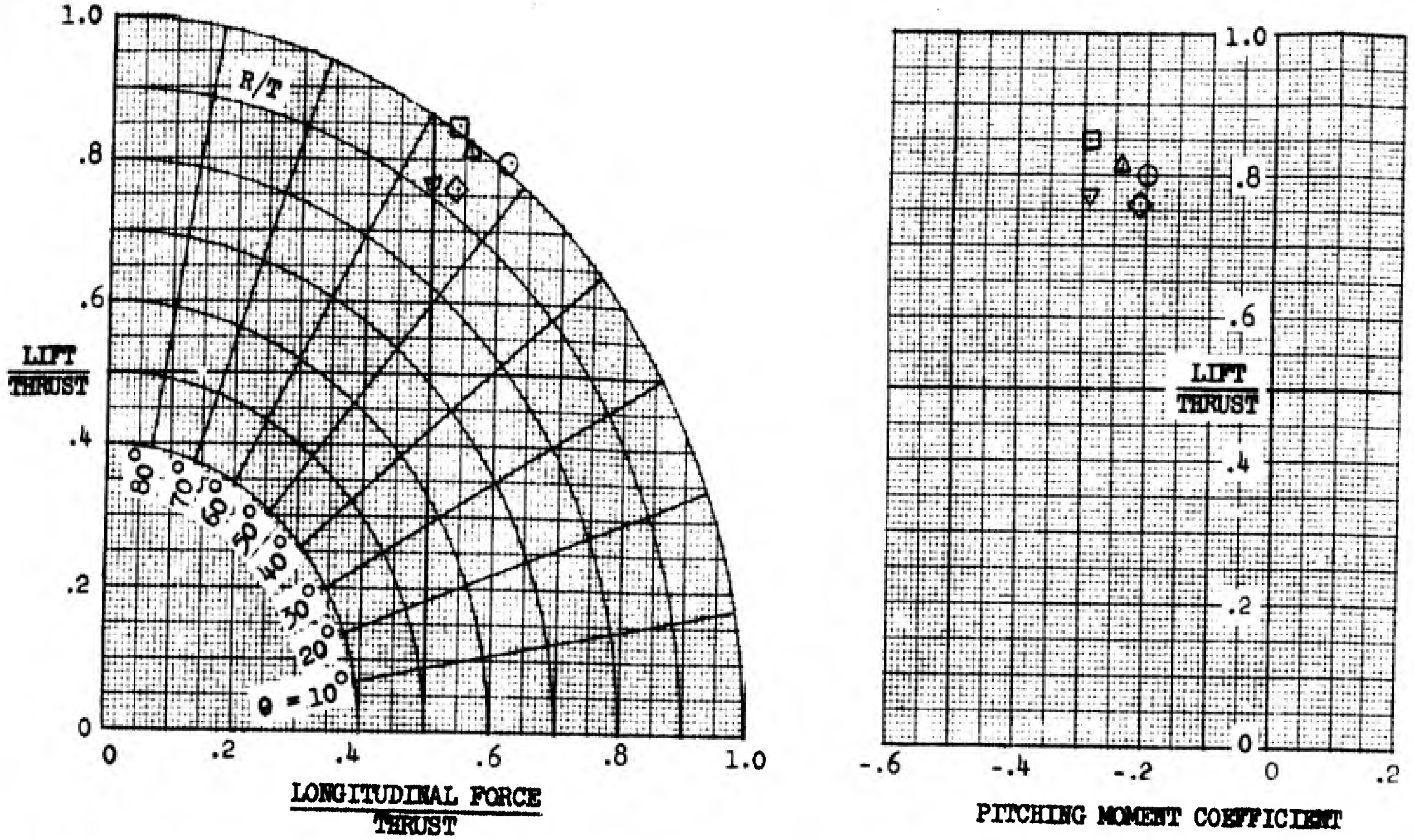
Effect of Upper Wing Flaps with Upper Wing at 20°

And Lower Wing at 5° Angle of Incidence

Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.24

SYM	RUN	D	E
○	B 15.1	30.00	21.50
△	B 15.2	35.00	29.00
□	B 15.3	40.00	37.00
▽	B 15.4	45.00	44.00
◇	B 15.5	42.50	40.50





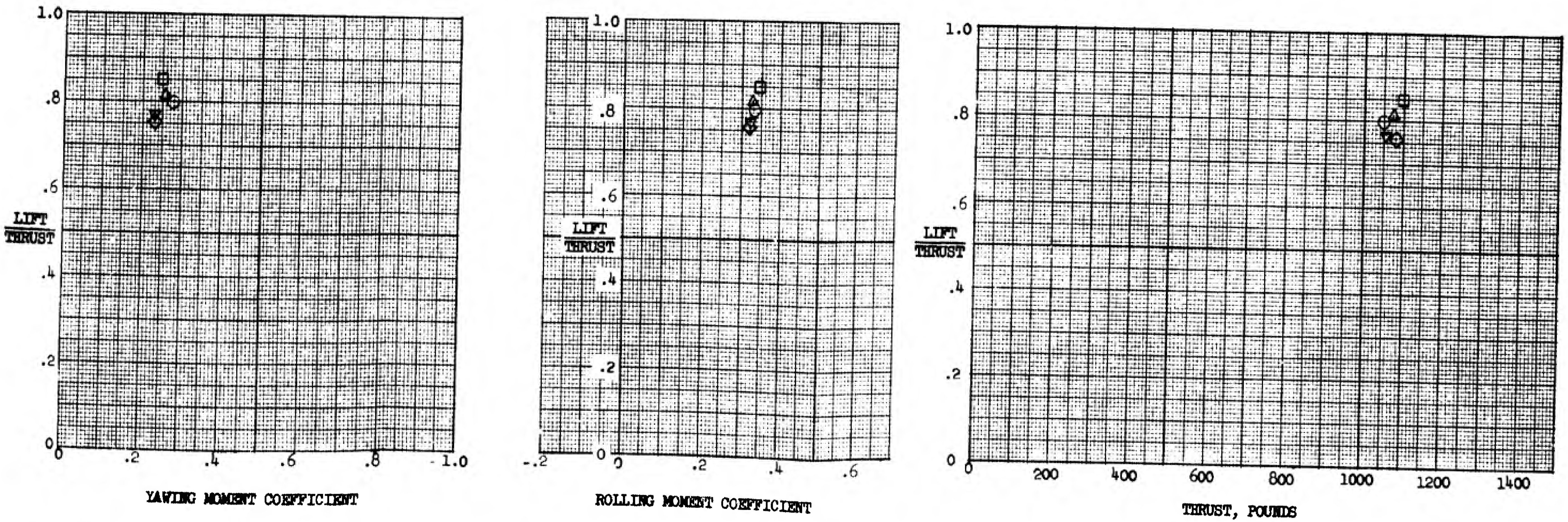


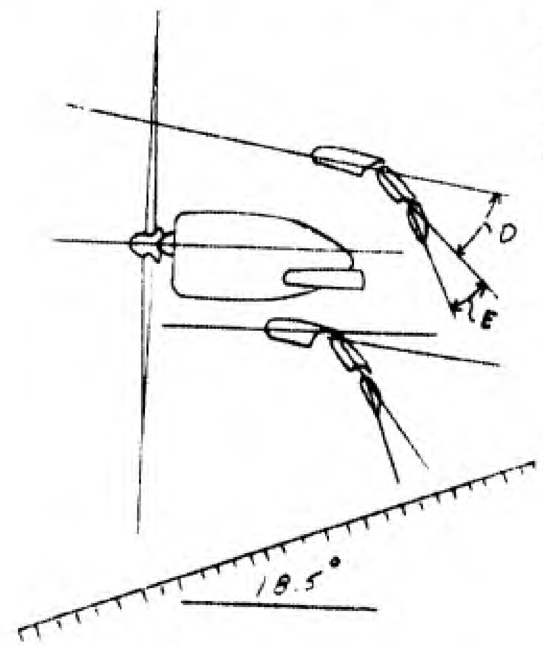
Figure 57

MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

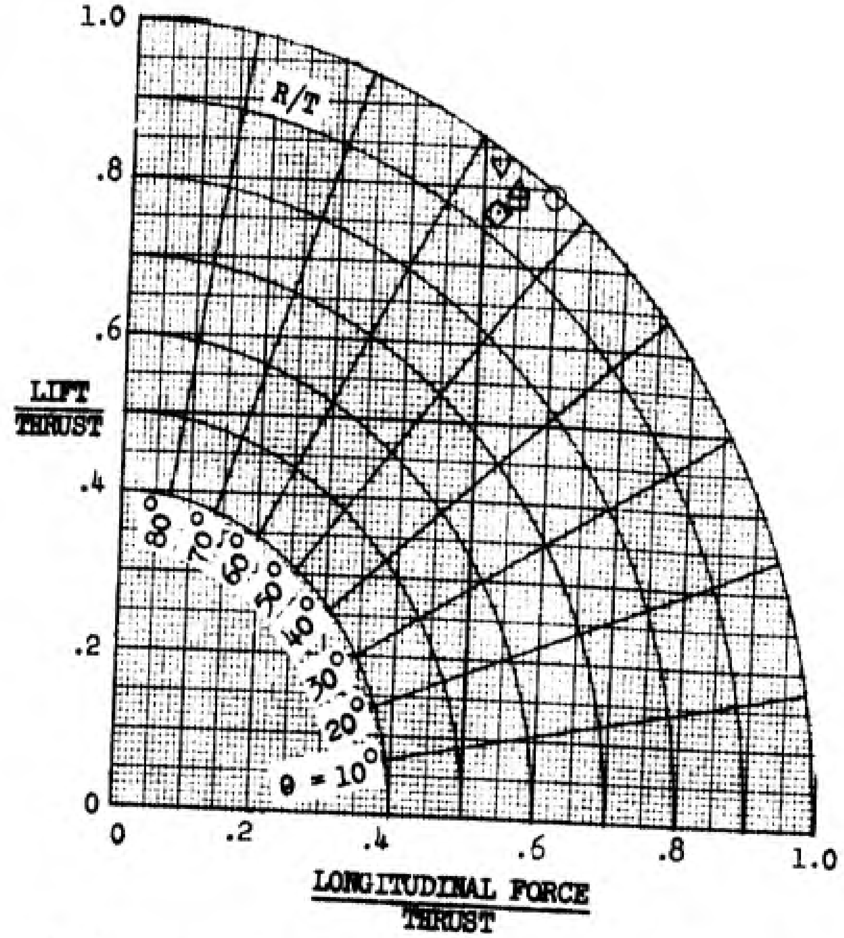
Effect of Upper Wing Flaps with Upper Wing at 20°

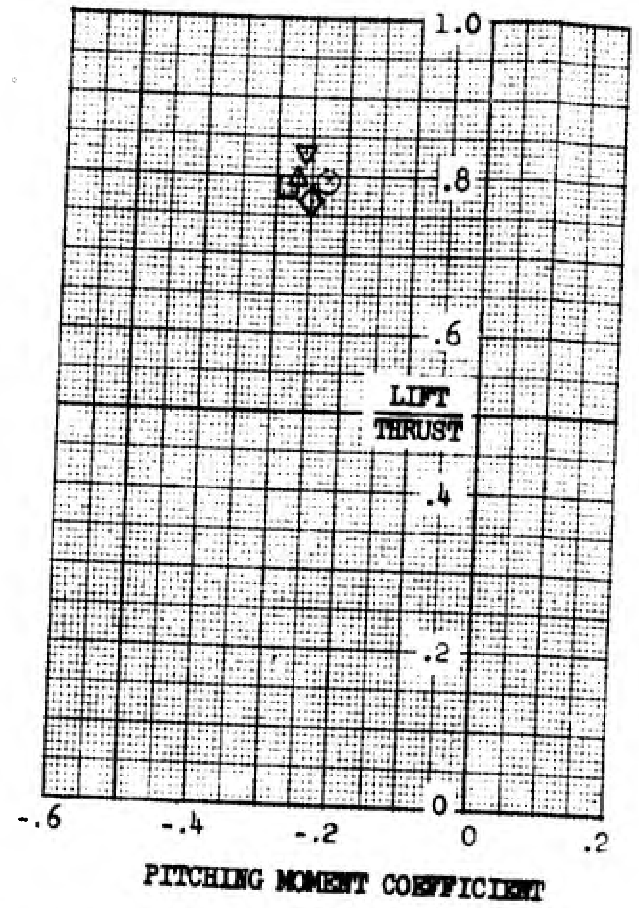
And Lower Wing at 5° Angle of Incidence

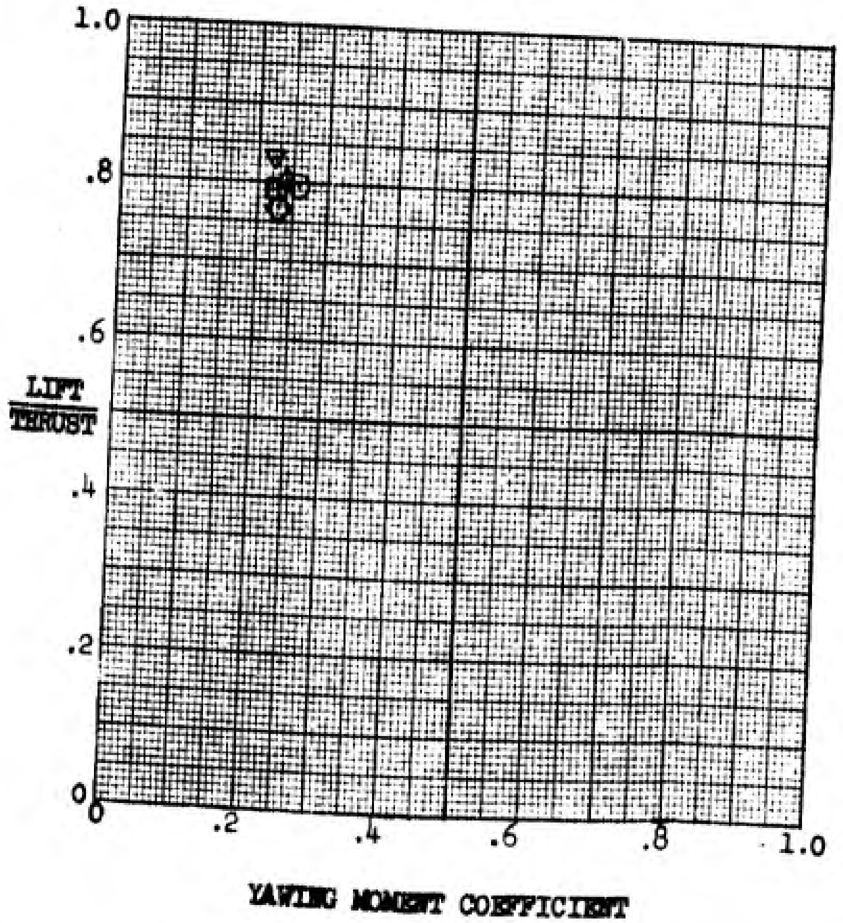


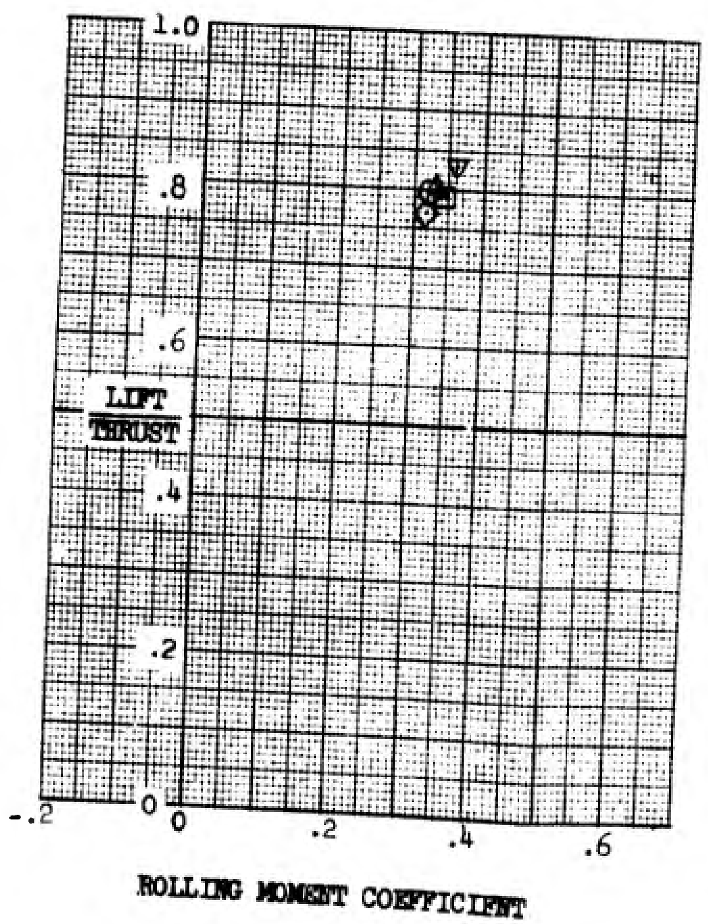
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

SYM	RUN	D	E
○	B 16.1	30.00	21.50
△	B 16.2	35.00	29.00
□	B 16.3	40.00	37.00
◇	B 16.4	45.00	44.00
▽	B 16.5	47.50	48.00









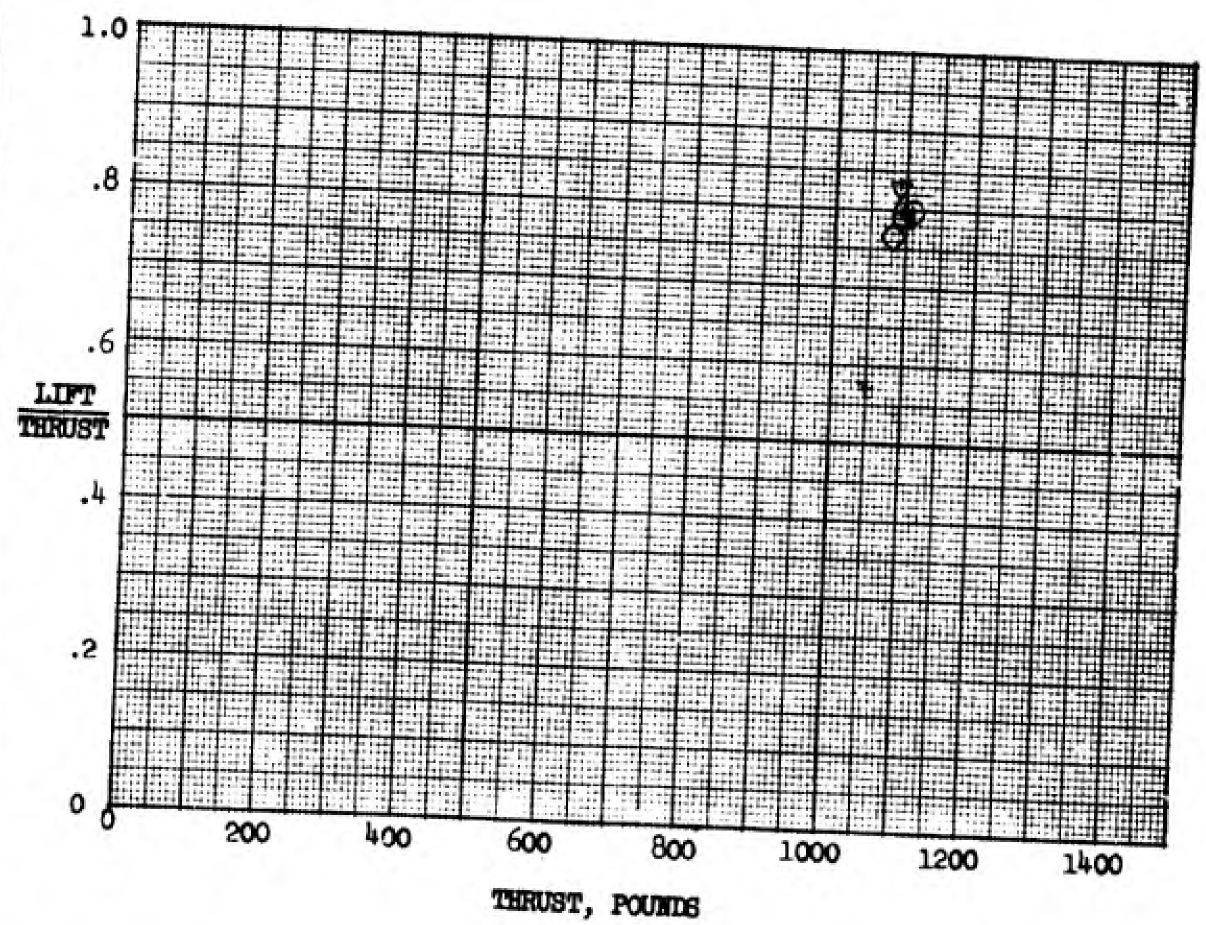


Figure 68

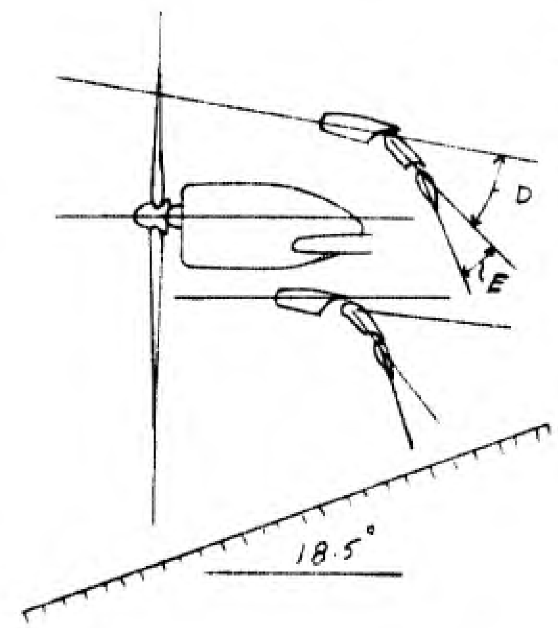
MODEL 88 BIPLANE CONFIGURATION

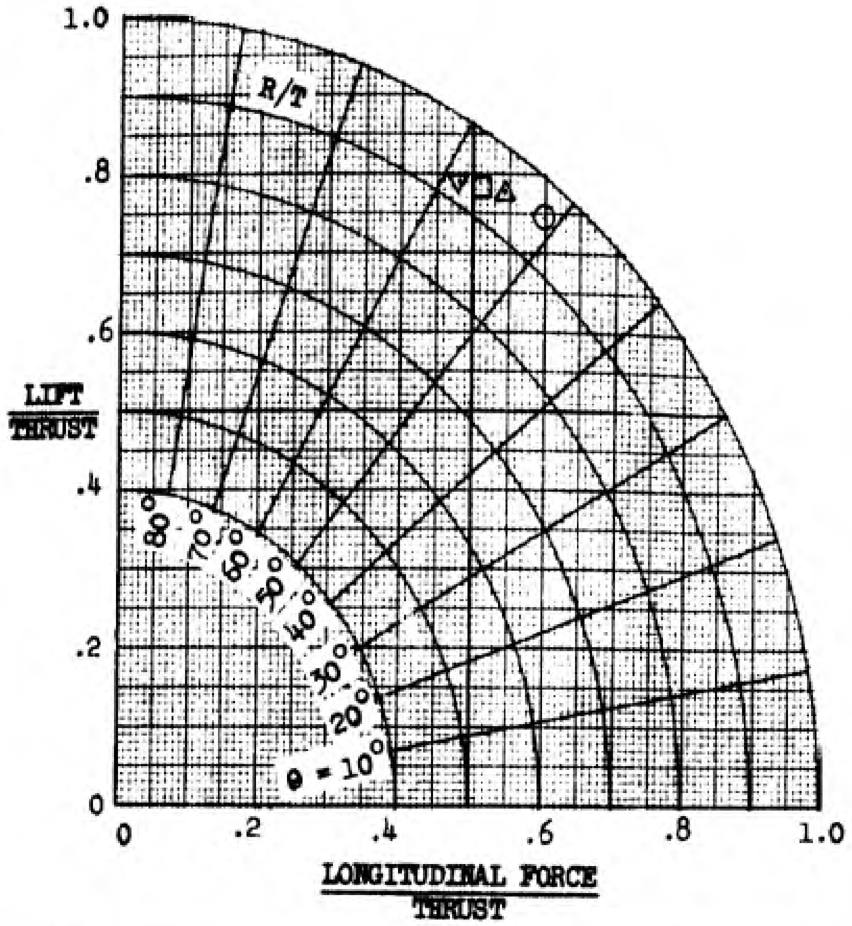
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

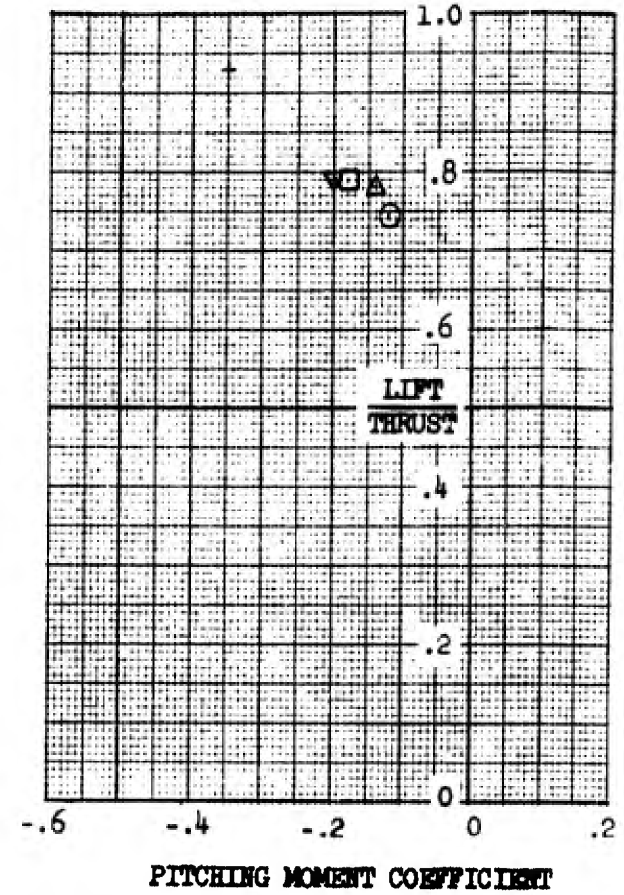
Effect of Upper Wing Flaps with Upper Wing at 20°
And Lower Wing at 5° Angle of Incidence

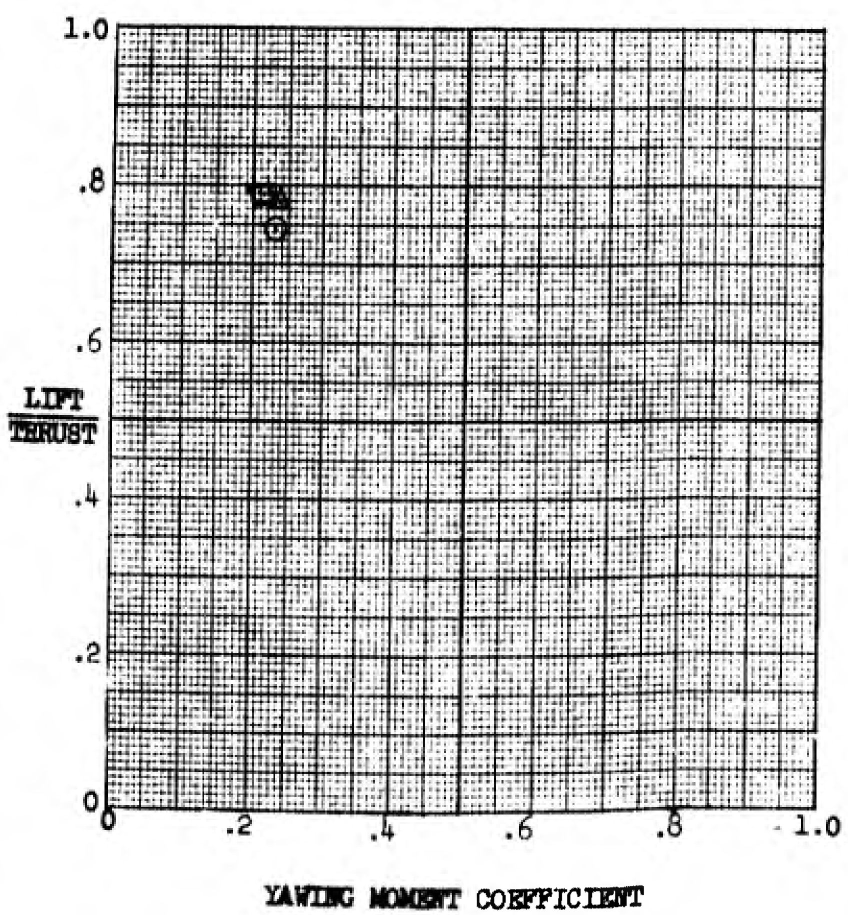
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.81
Stagger/chord ratio = -1.53
Ground plane installed

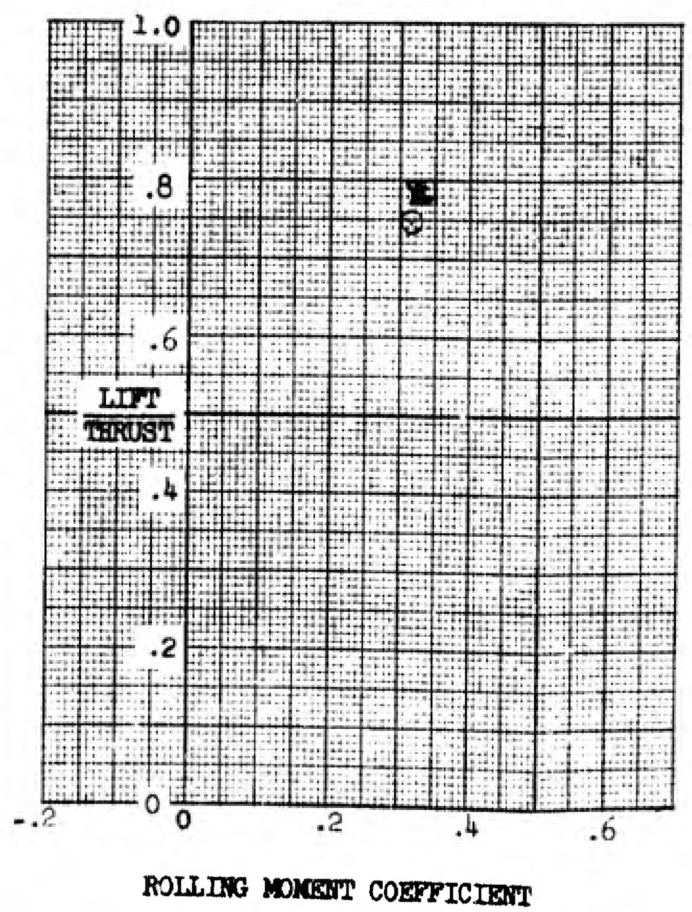
SYM	RUN	D	E
○	B 17.1	30.00	21.50
△	B 17.2	35.00	29.00
□	B 17.3	40.00	37.00
▽	B 17.4	45.00	44.00











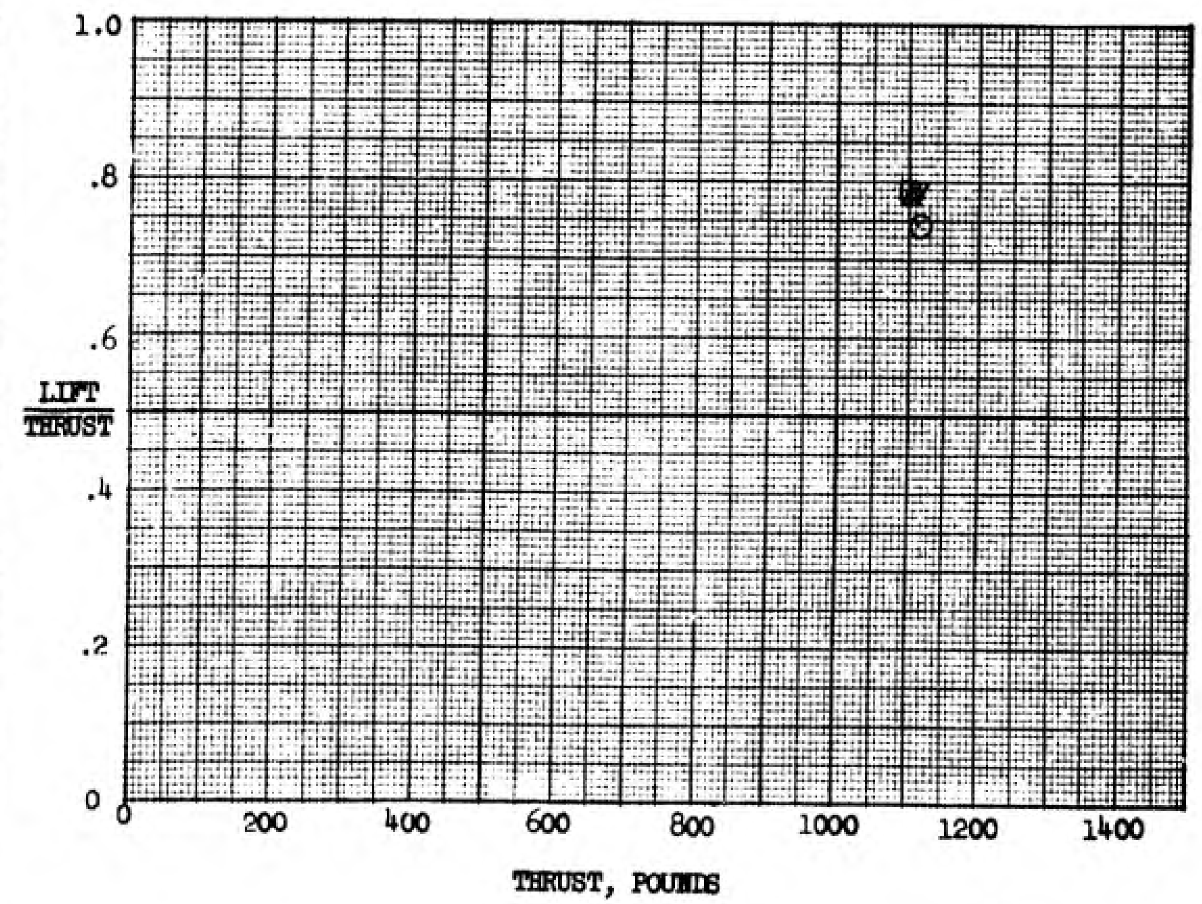


Figure 59

MODEL 88 BIPLANE CONFIGURATION

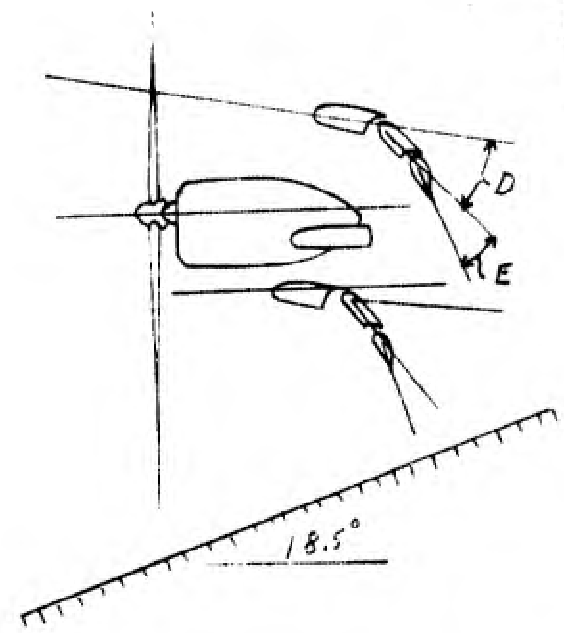
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

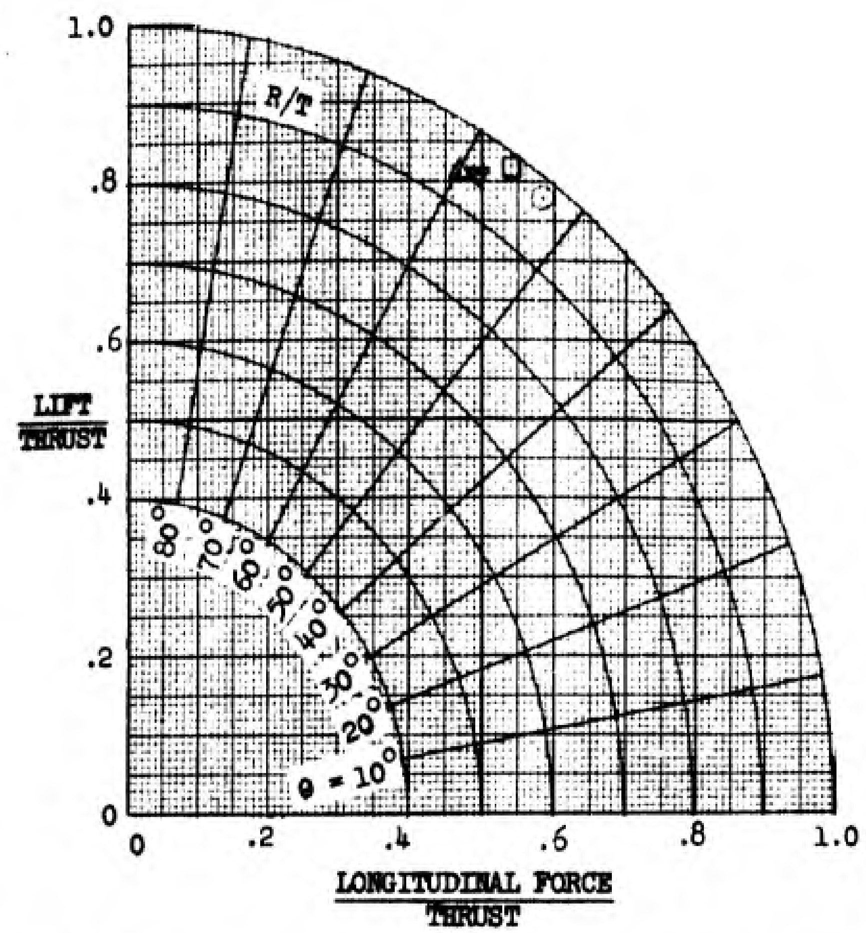
Effect of Upper Wing Flaps with Upper Wing at 20°

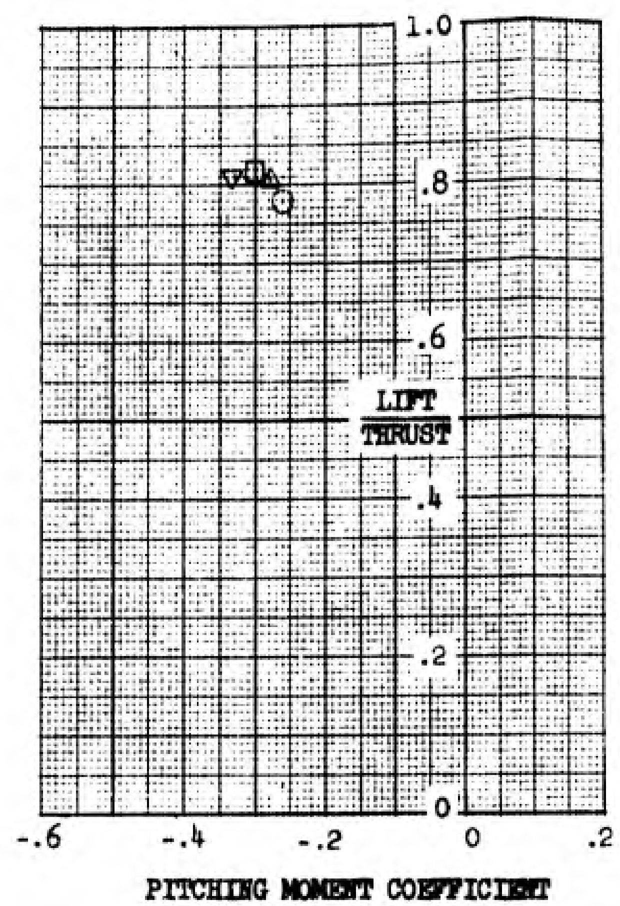
And Lower Wing at 5° Angle of Incidence

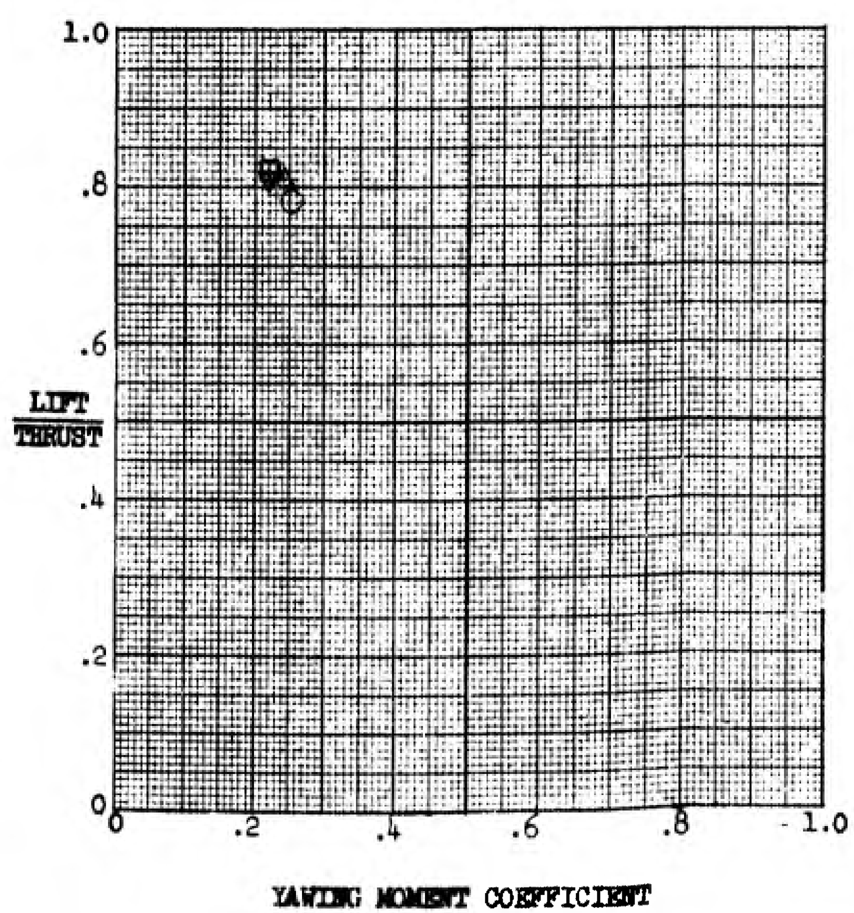
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.82
Ground Plane installed

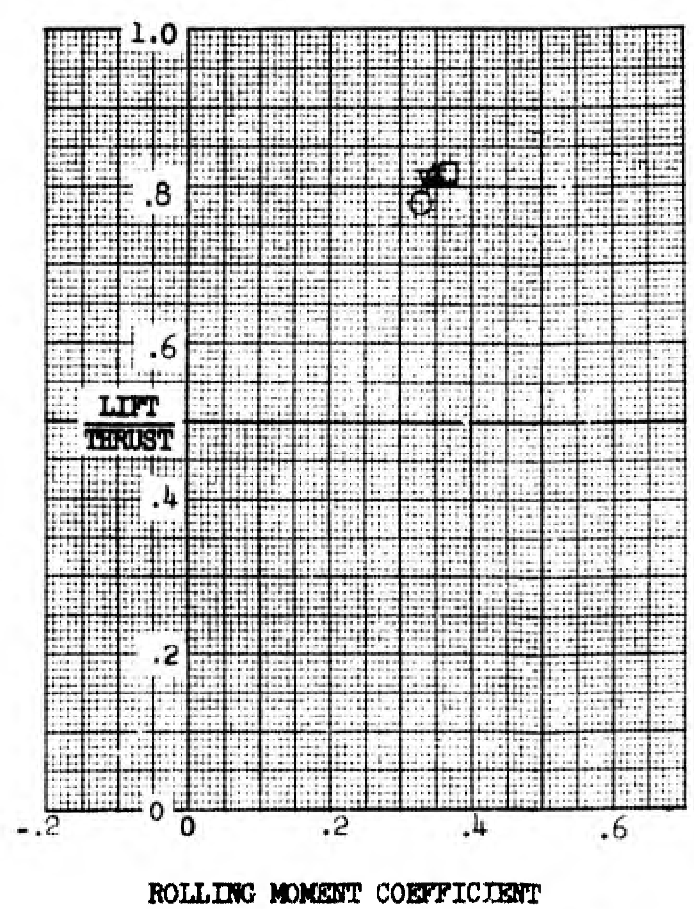
SYM	RUN	D	E
○	B 18.1	30.00	21.50
△	B 18.2	35.00	29.00
□	B 18.3	40.00	37.00
▽	B 18.4	45.00	44.00

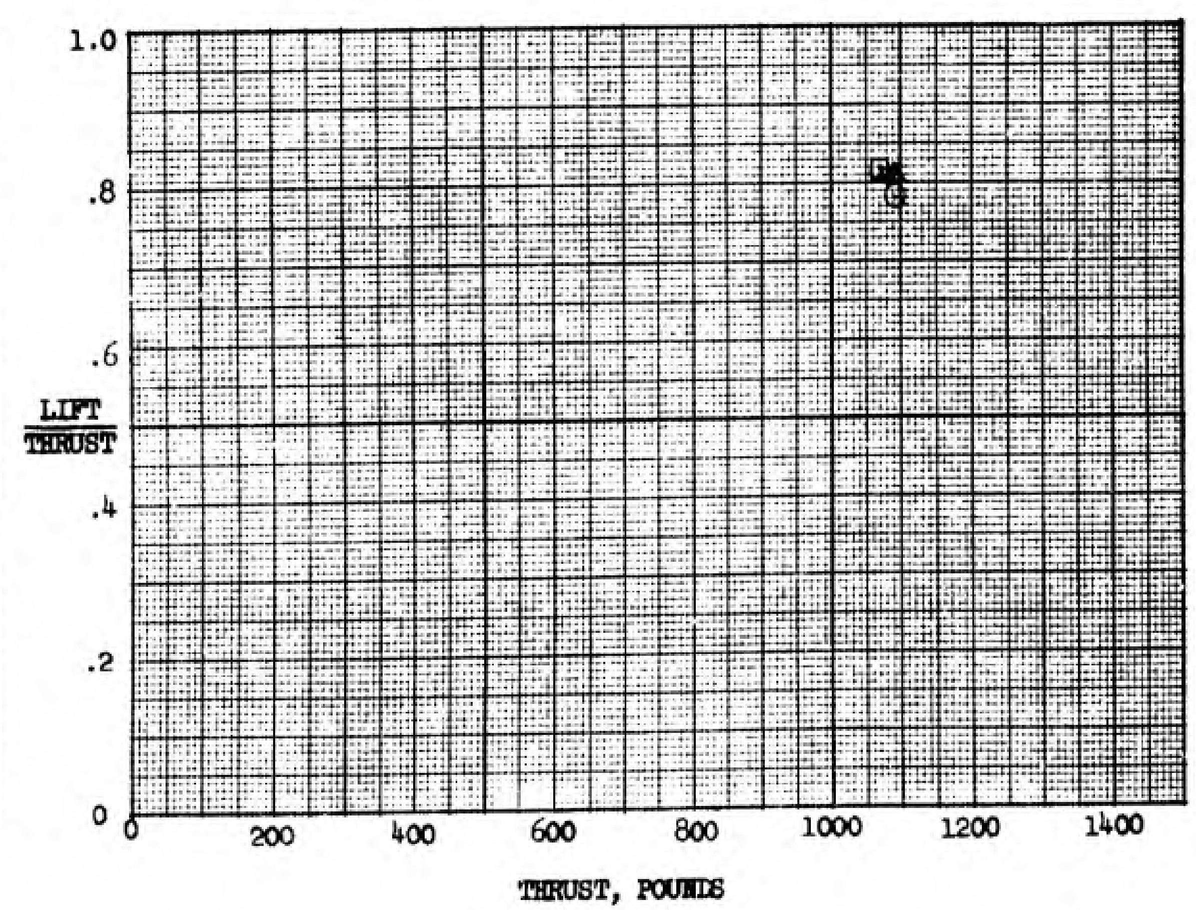












MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

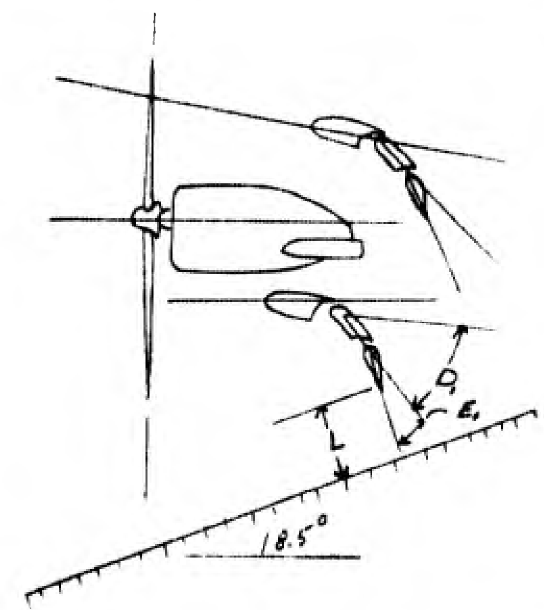
Effect of Lower Wing Flaps with Upper Wing at 20°

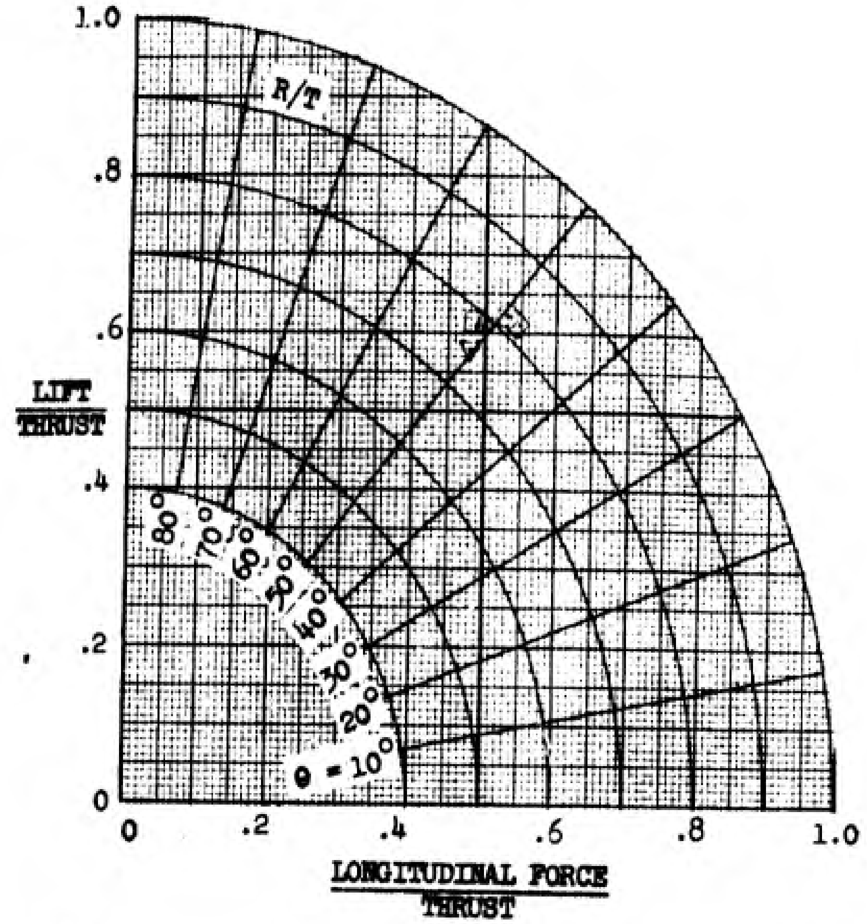
And Lower Wing at 5° Angle of Incidence

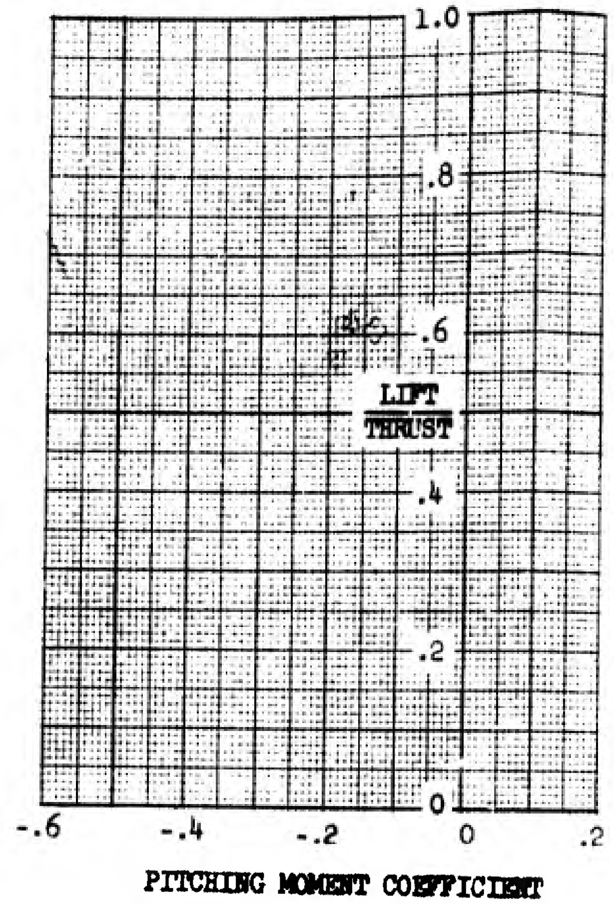
Figure 70

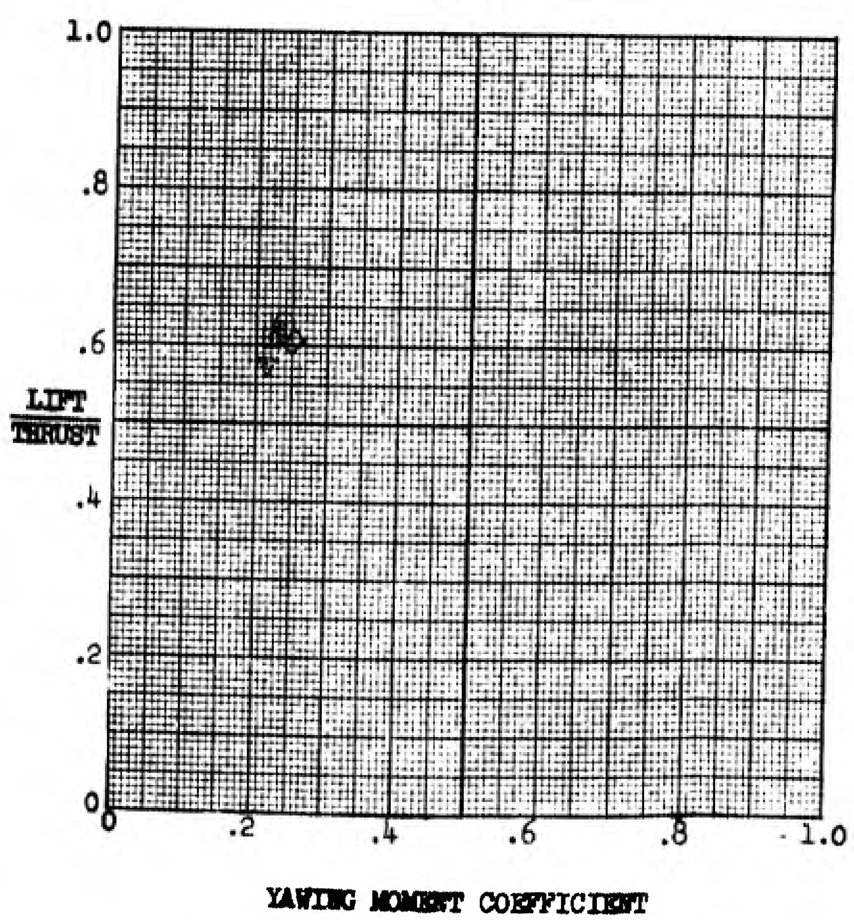
Upper wing forward flap = 40° deflection
Upper wing aft flap = 37° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

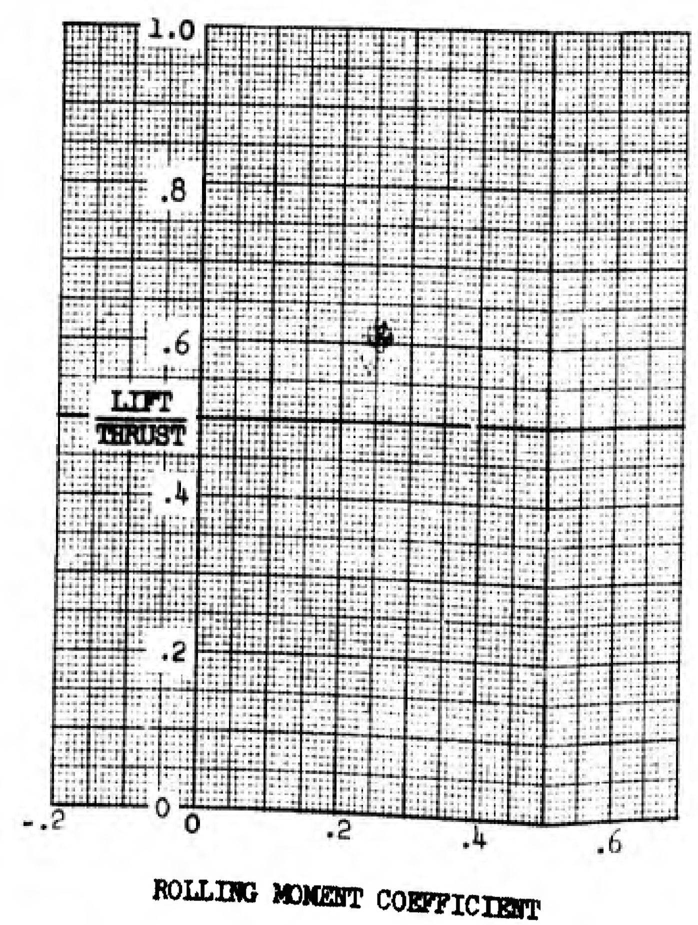
SYM	RUN	D_1	E_1	L
○	B 6.1	40.00	37.00	9.00
△	B 6.2	45.00	44.00	7.88
□	B 6.3	50.00	51.00	7.38
▽	B 6.4	55.00	58.50	7.25
◇	B 6.5	35.00	29.00	10.75











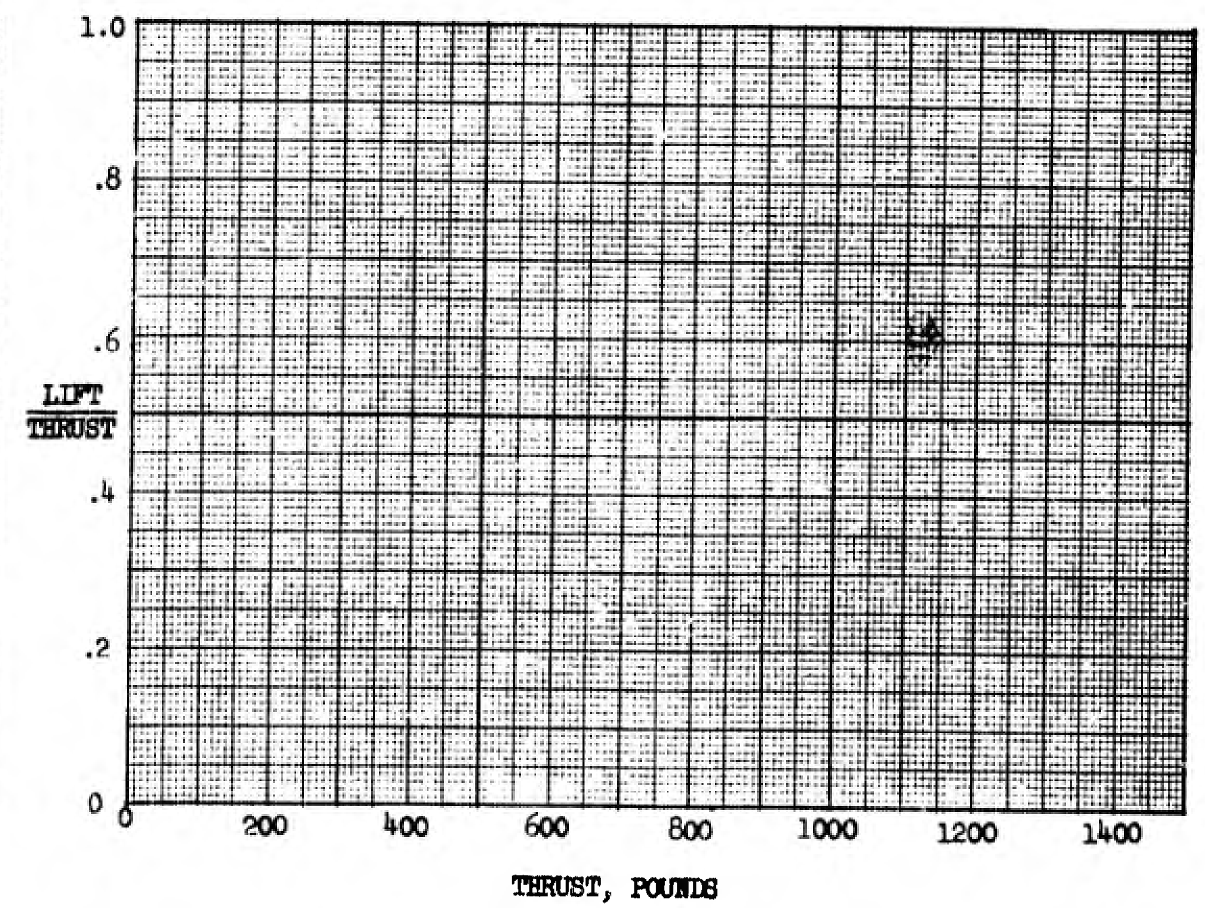


Figure 71

MODEL 88 BIPLANE CONFIGURATION

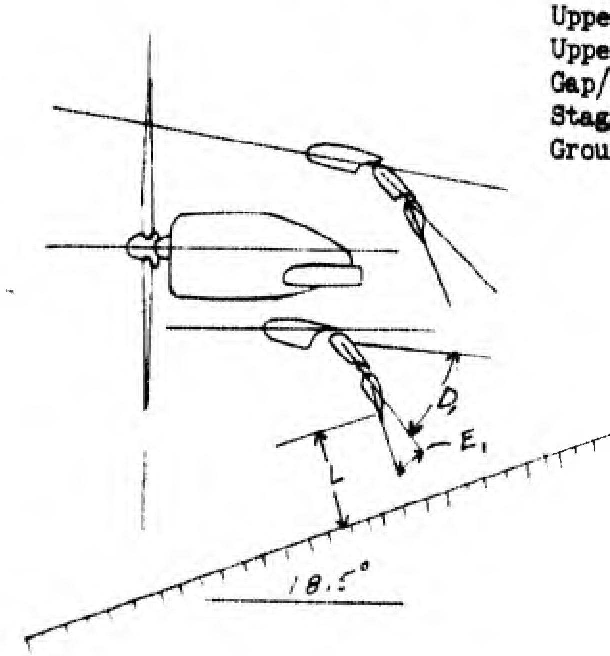
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

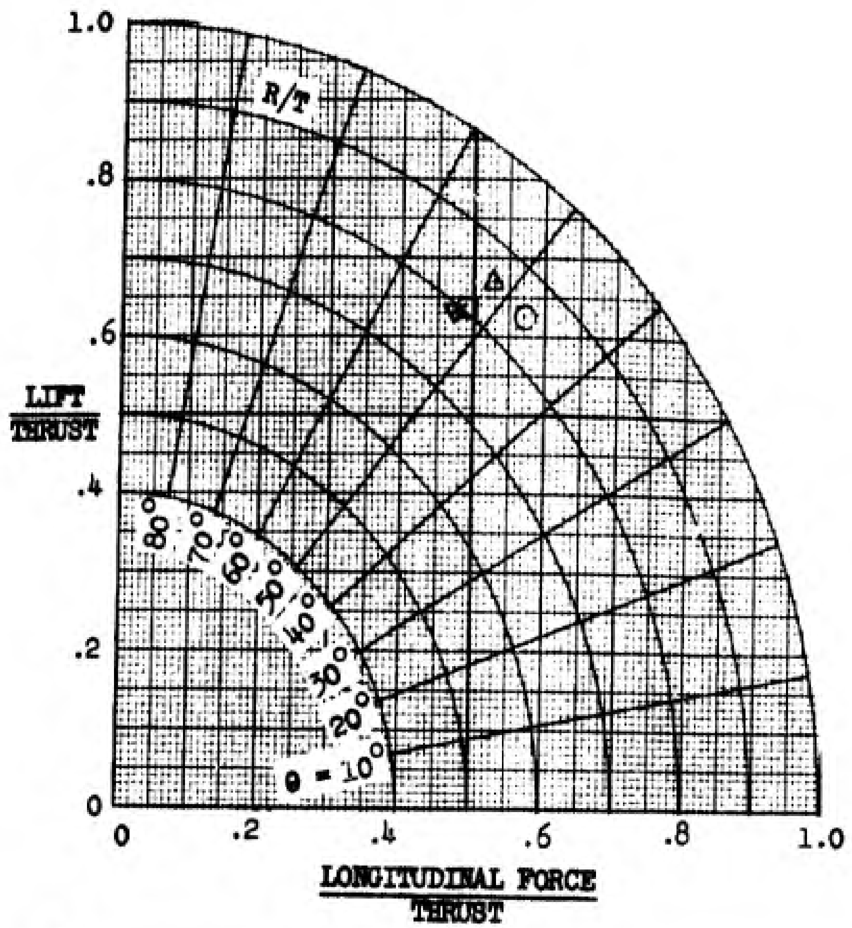
Effect of Lower Wing Flaps with Upper Wing at 20°

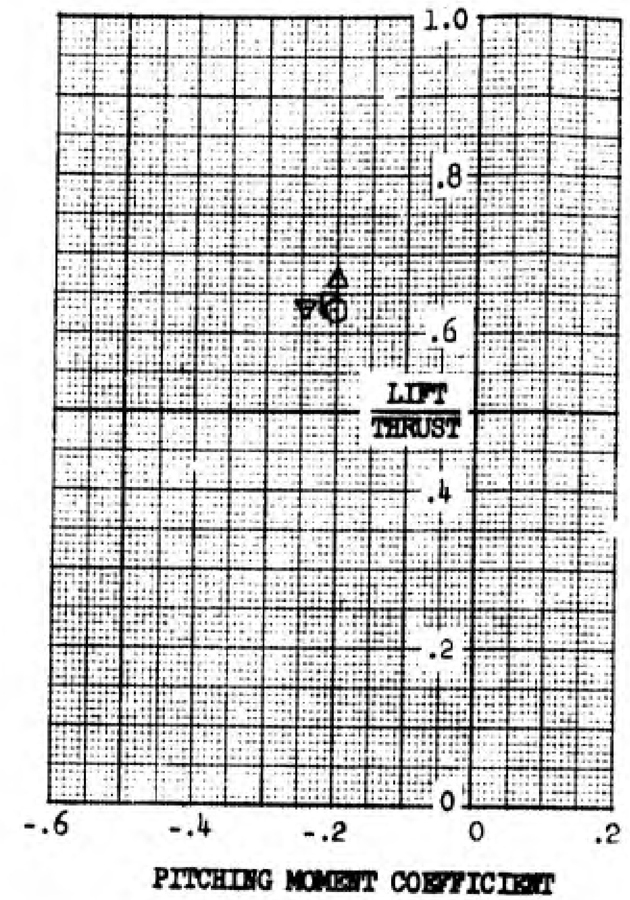
And Lower Wing at 5° Angle of Incidence

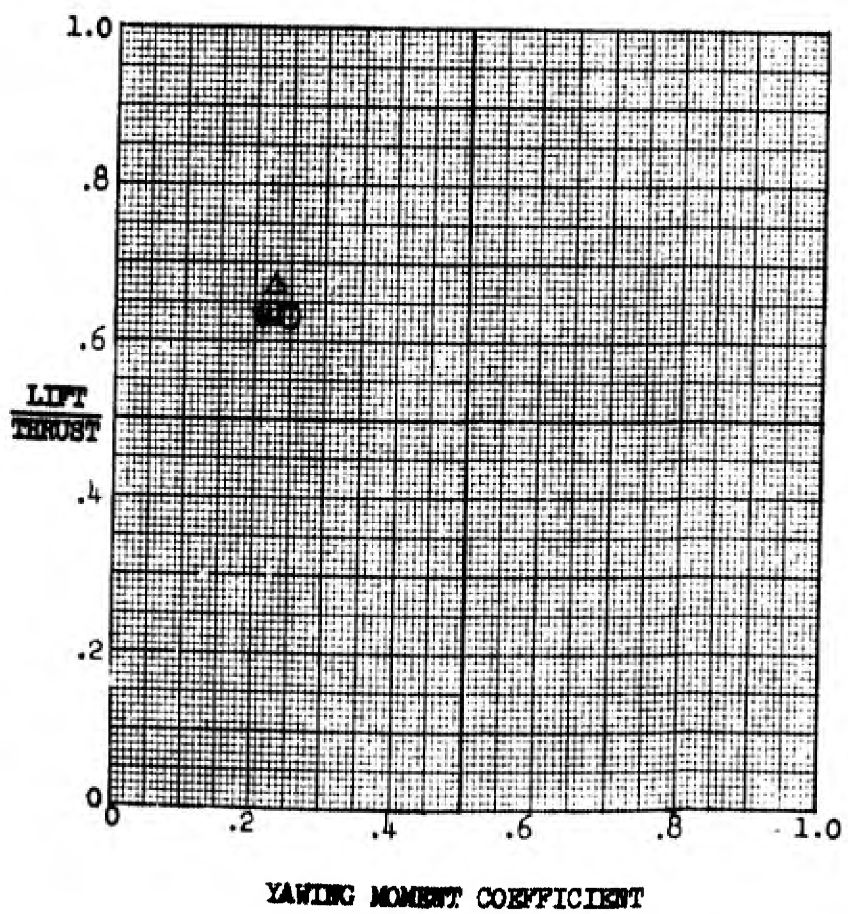
Upper wing forward flap = 40° deflection
Upper wing aft flap = 37° deflection
Gap/chord ratio = 0.89
Stagger/chord ratio = -0.32
Ground plane installed

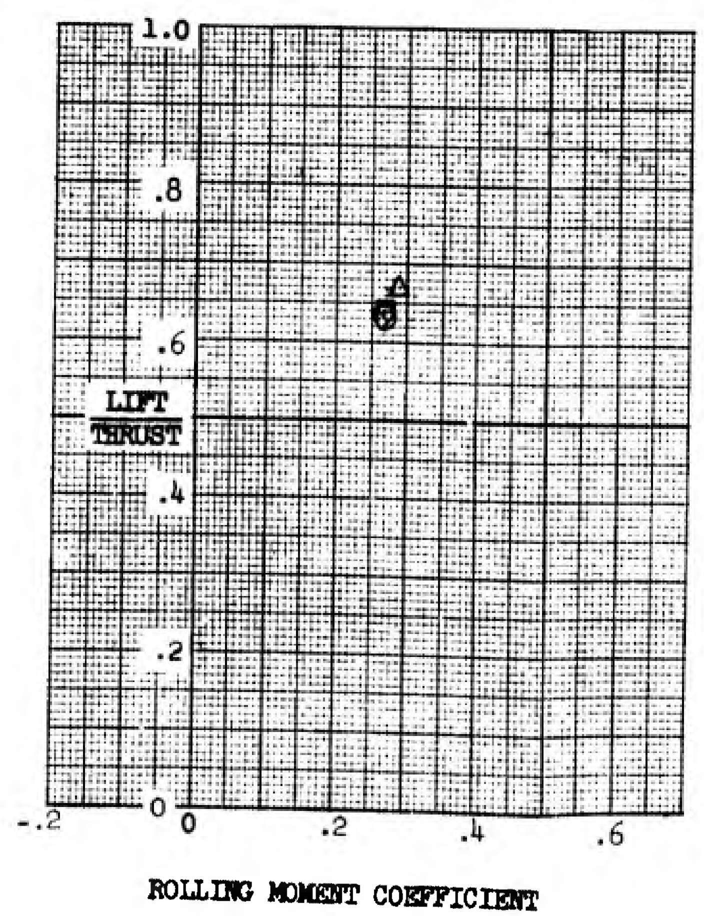
SYM	RUN	D_1	E_1	L
○	B 8.1	35.00	29.00	16.00
⊥	B 8.2	40.00	37.00	14.38
□	B 8.3	45.00	44.00	13.25
▽	B 8.4	50.00	51.00	13.00











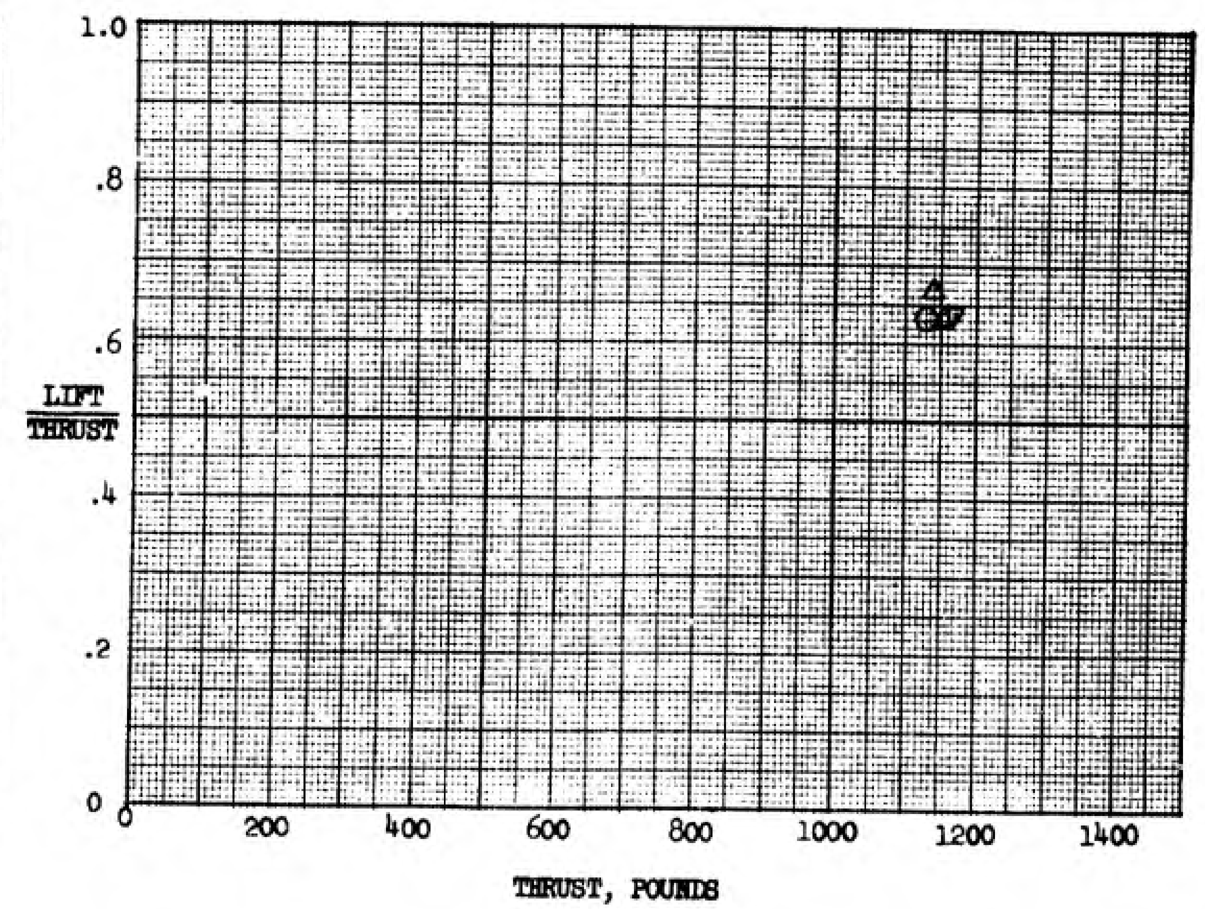


Figure 72

MODEL 88 BIPLANE CONFIGURATION

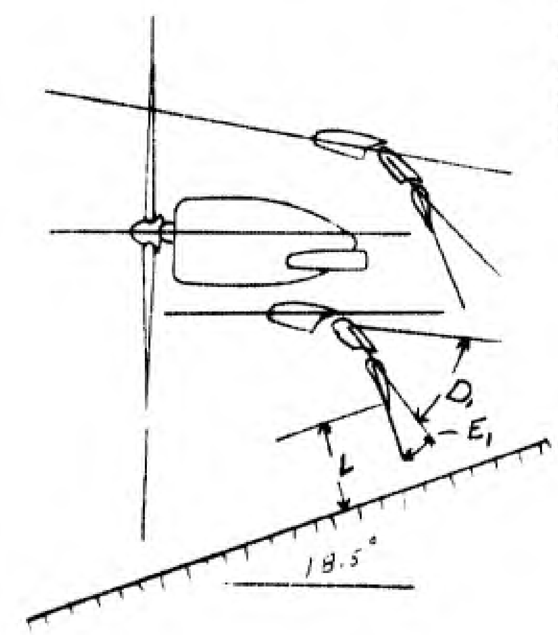
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

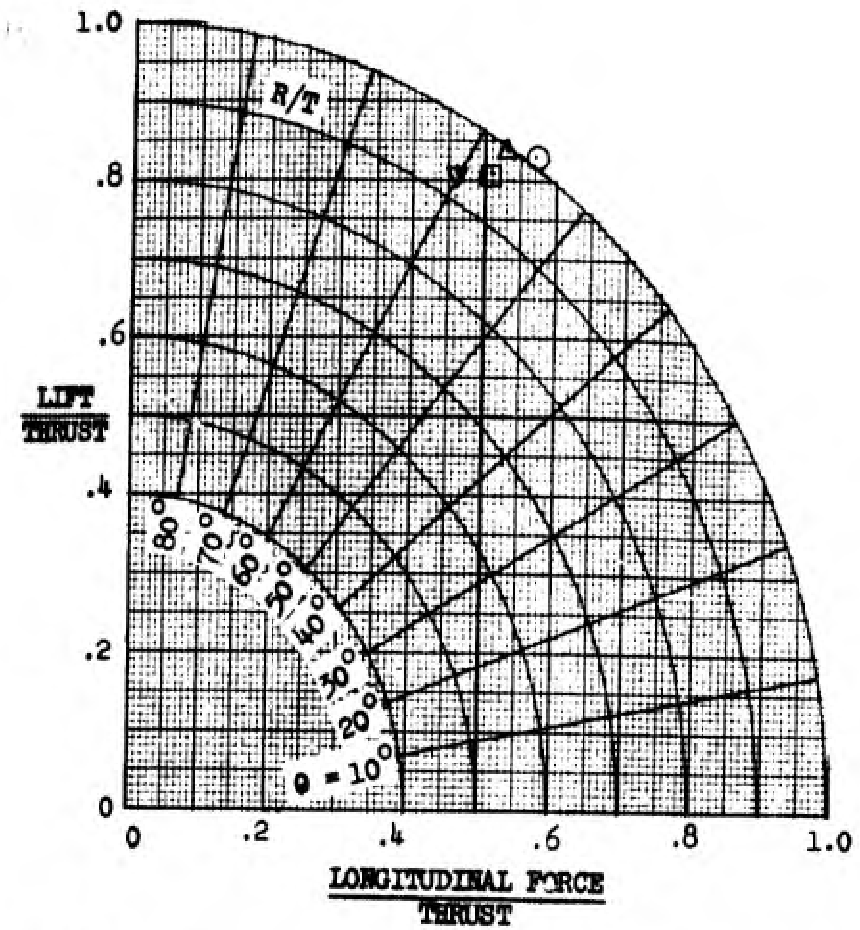
Effect of Lower Wing Flaps with Upper Wing at 20°

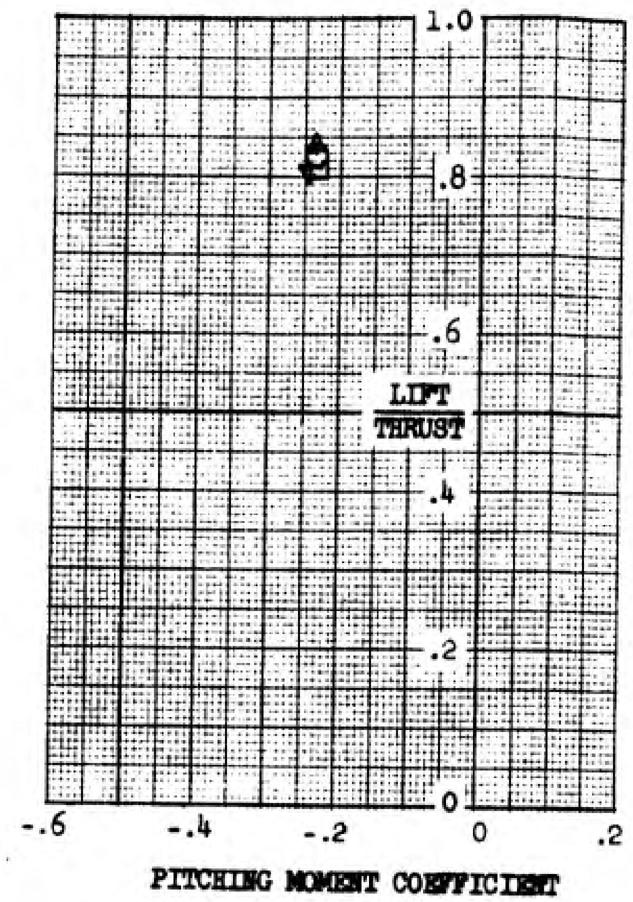
And Lower Wing at 7.5° Angle of Incidence

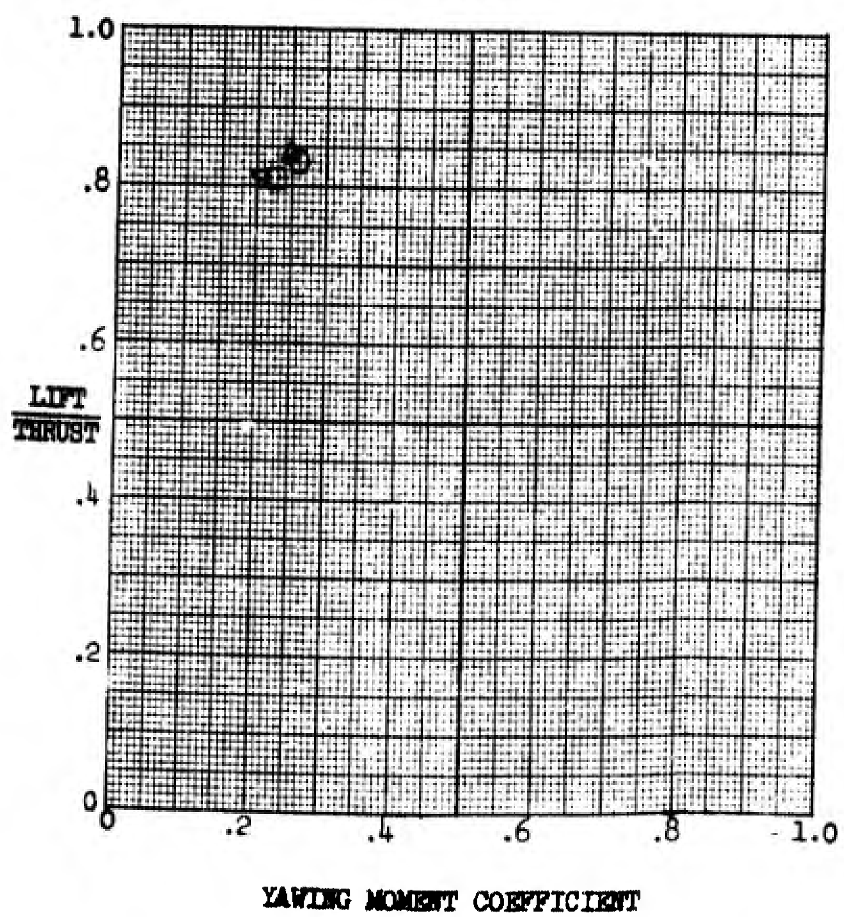
Upper wing forward flap = 42.5° deflection
Upper wing aft flap = 40.5° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

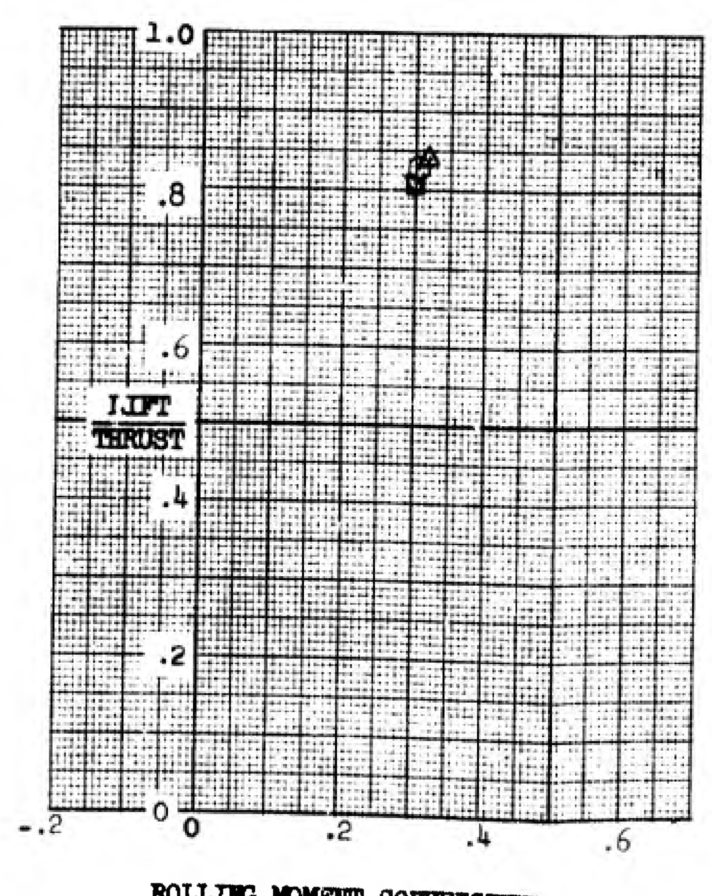
SYM	RUN	D_1	E_1	L
○	B 19.1	30.00	21.50	19.00
△	B 19.2	35.00	29.00	16.75
□	B 19.3	40.00	37.00	15.50
	B 19.4	45.00	44.00	14.75











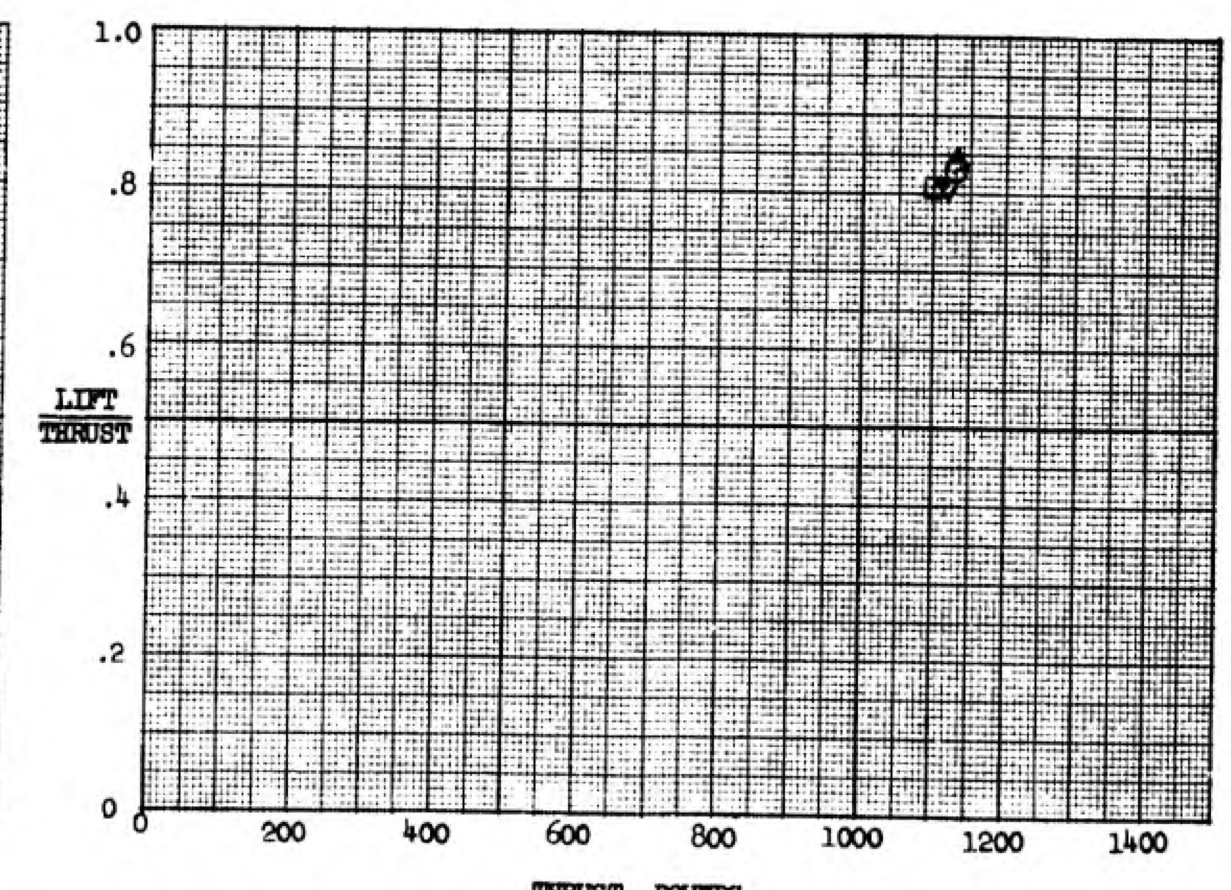


Figure 73

MODEL 88 BIPLANE CONFIGURATION

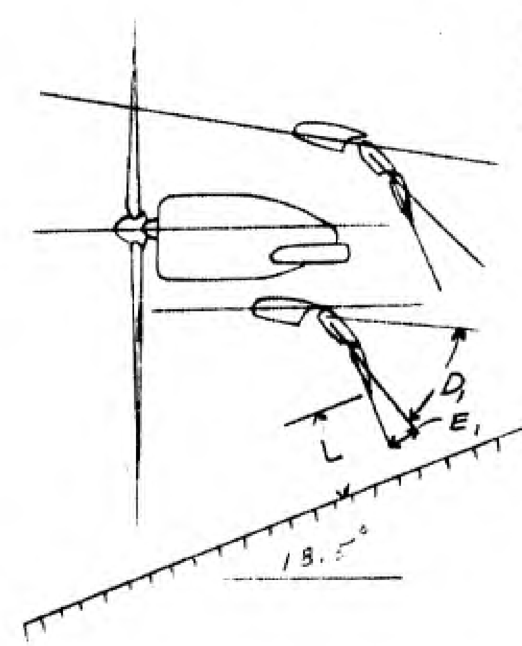
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

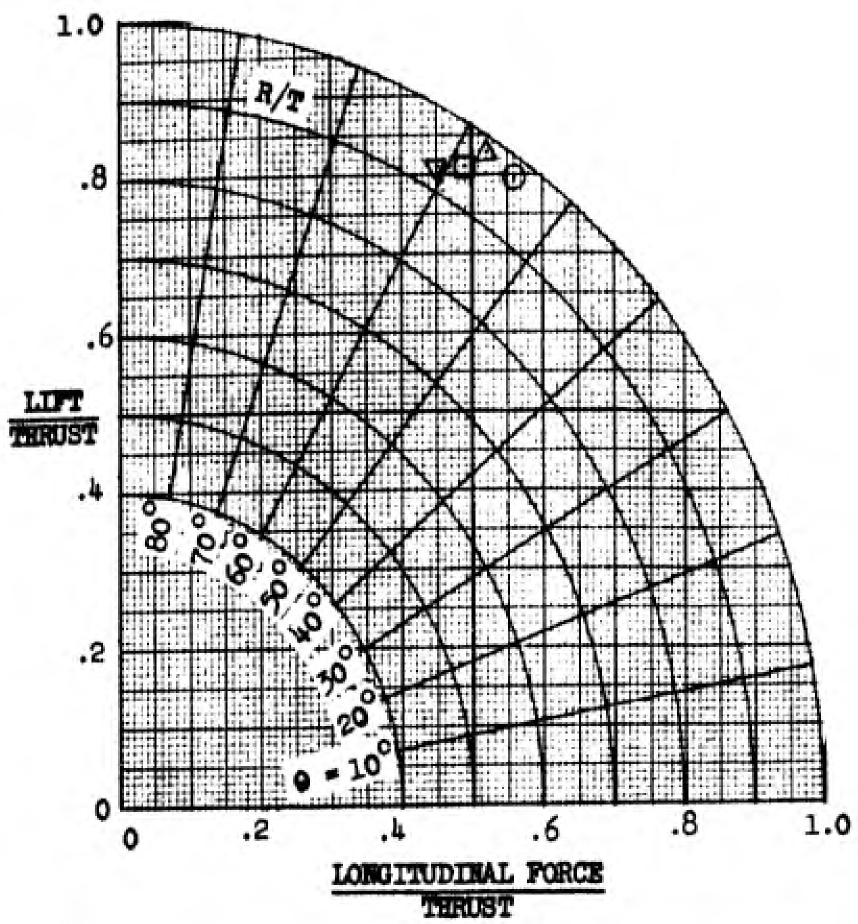
Effect of Lower Wing Flaps With Upper Wing at 20°

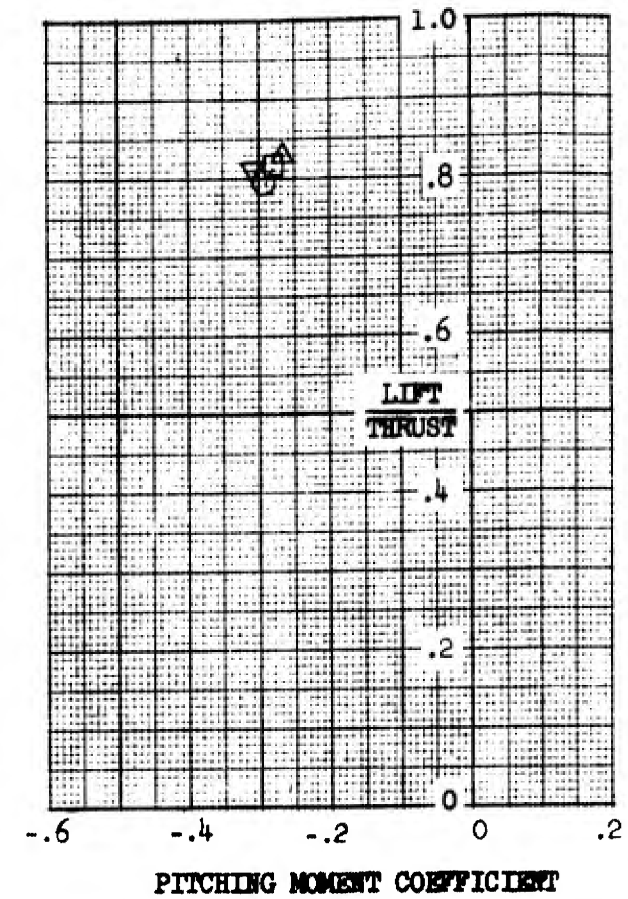
And Lower Wing at 10° Angle of Incidence

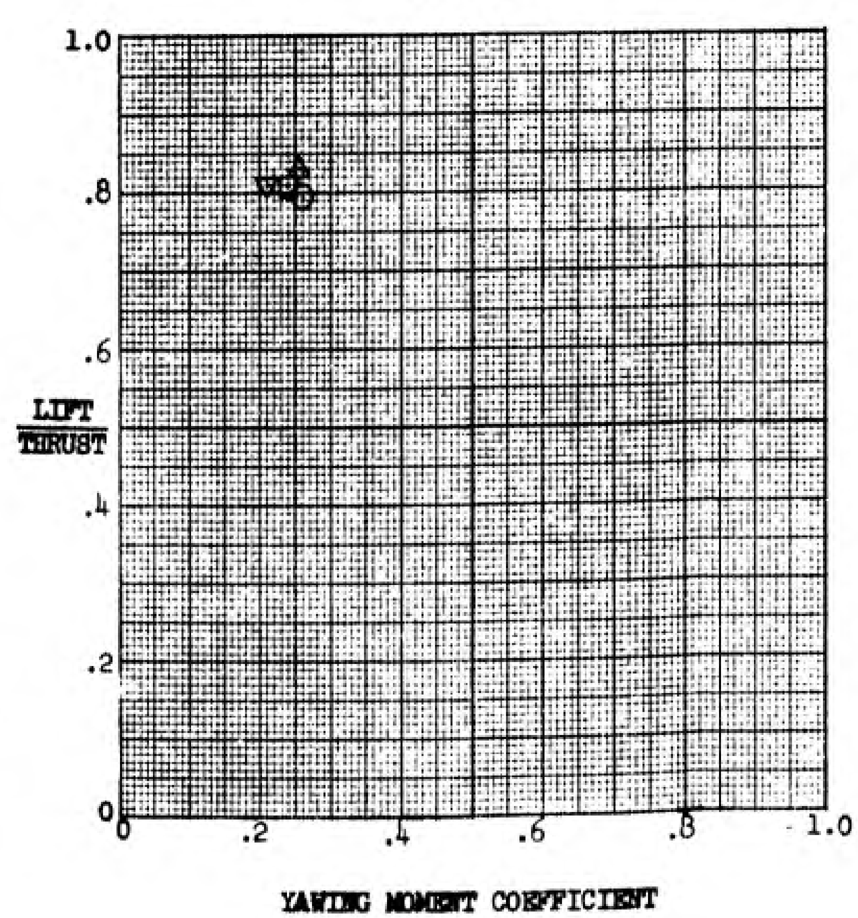
Upper wing forward flap = 42.5° deflection
Upper wing aft flap = 40.5° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

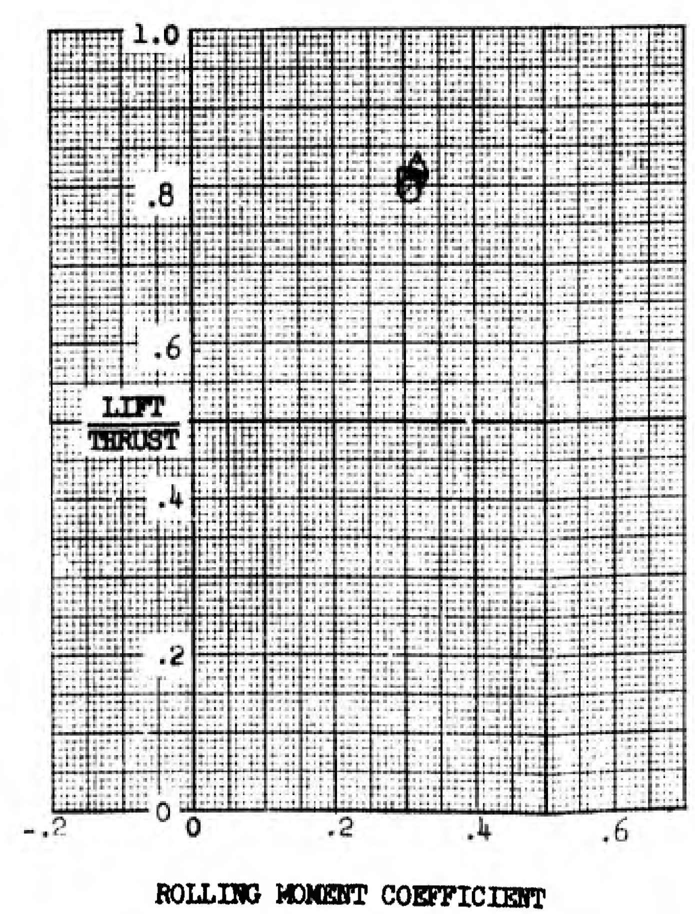
SYM	RUN	D_1	E_1	L
○	B 20.1	30.00	21.50	18.00
△	B 20.2	35.00	29.00	15.75
□	B 20.3	40.00	37.00	14.50
▽	B 20.4	45.00	44.00	13.75











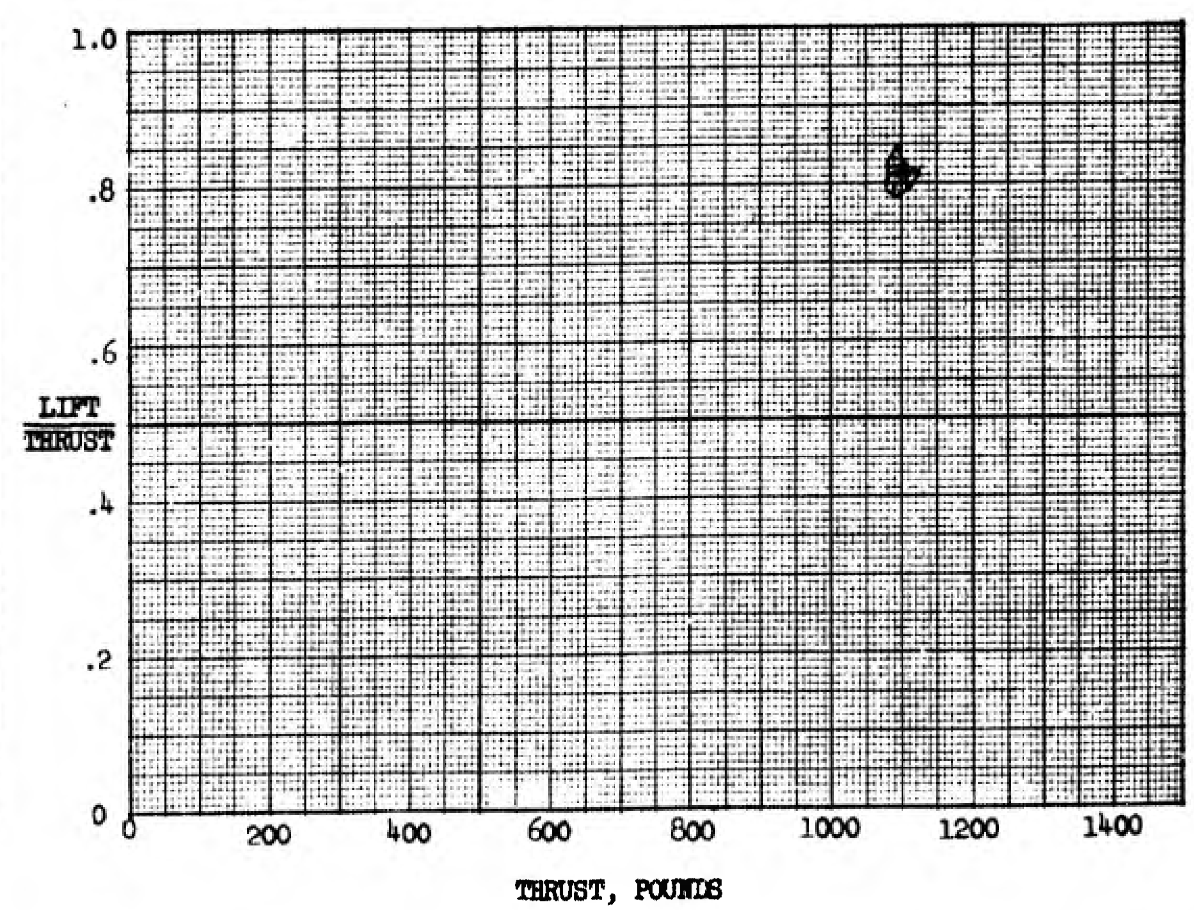


Figure 74

MODEL 88 BIPLANE CONFIGURATION

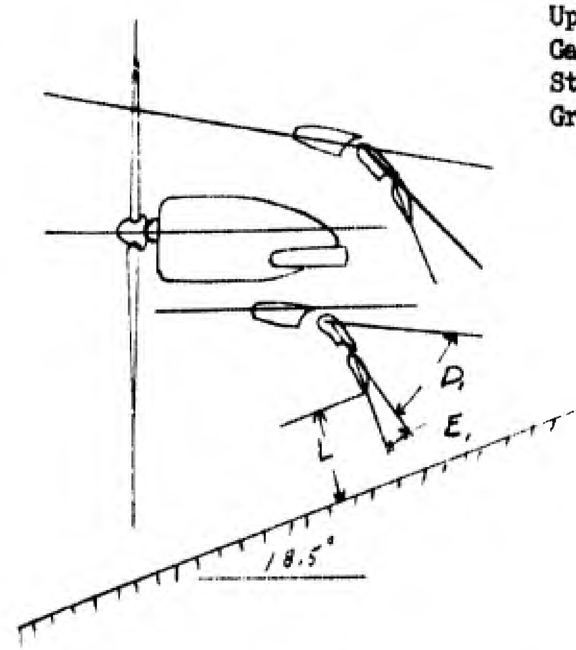
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

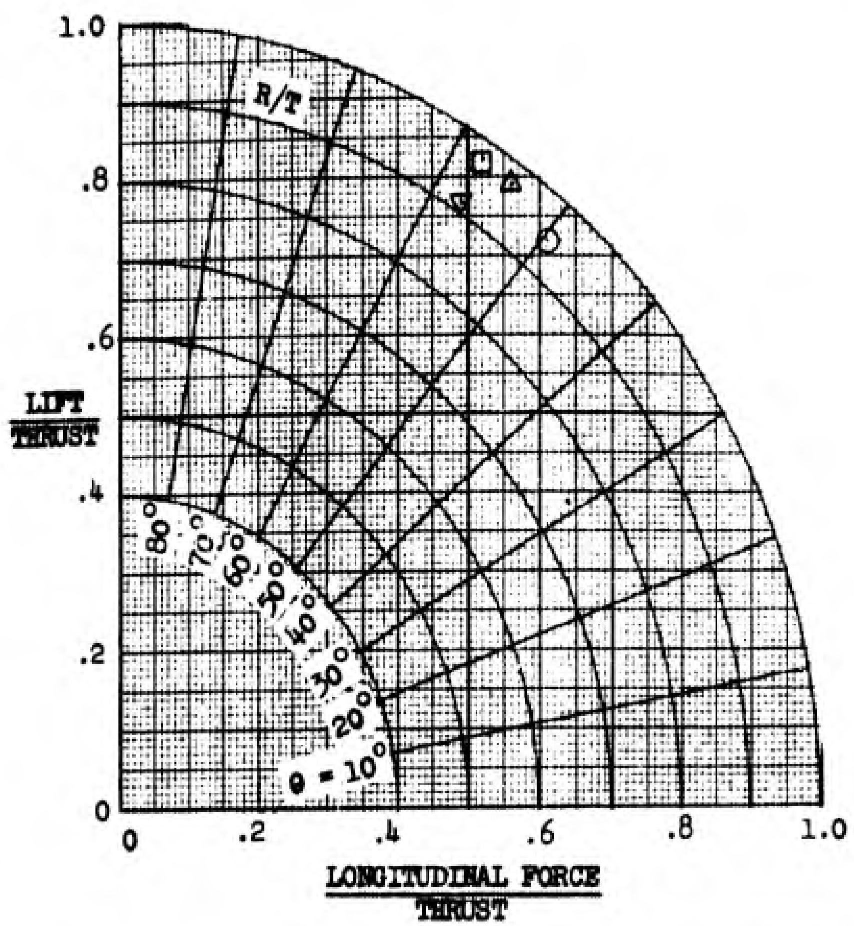
Effect of Lower Wing Flaps with Upper Wing at 20°

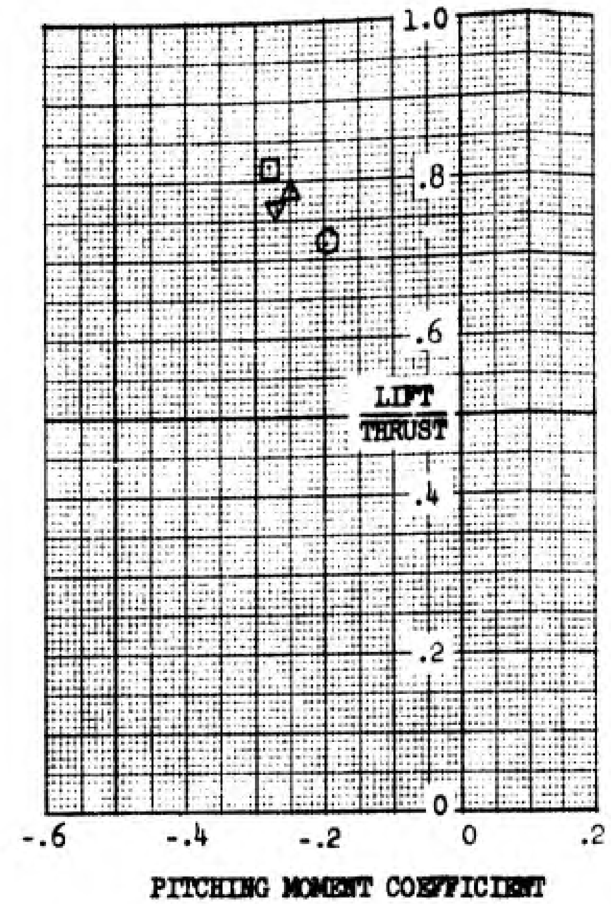
And Lower Wing at 12.5° Angle of Incidence

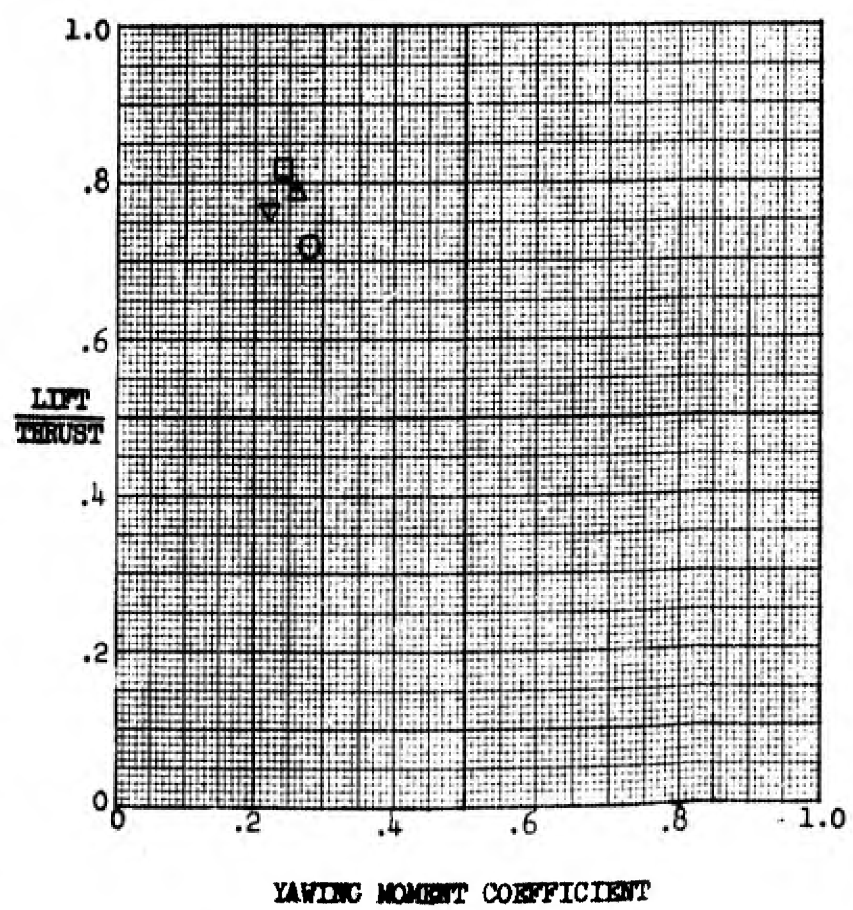
Upper wing forward flap = 42.5° deflection
Upper wing aft flap = 40.5° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.525
Ground plane installed

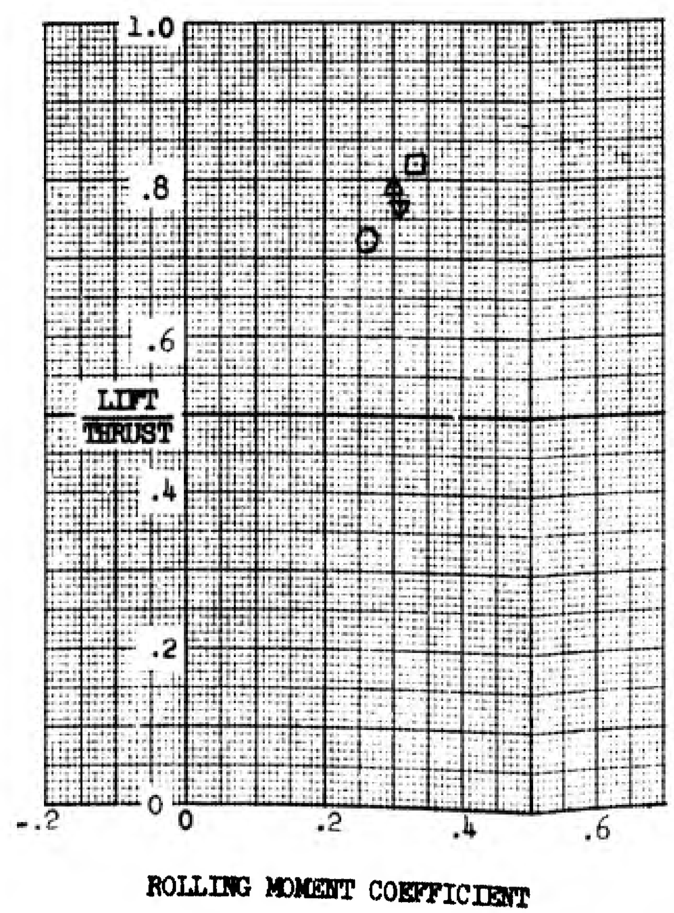
SYM	RUN	D_1	E_1	L
○	B 21.1	25.00	14.50	19.25
□	B 21.2	30.00	21.50	16.50
△	B 21.3	35.00	29.00	14.50
▽	B 21.4	40.00	37.00	13.50

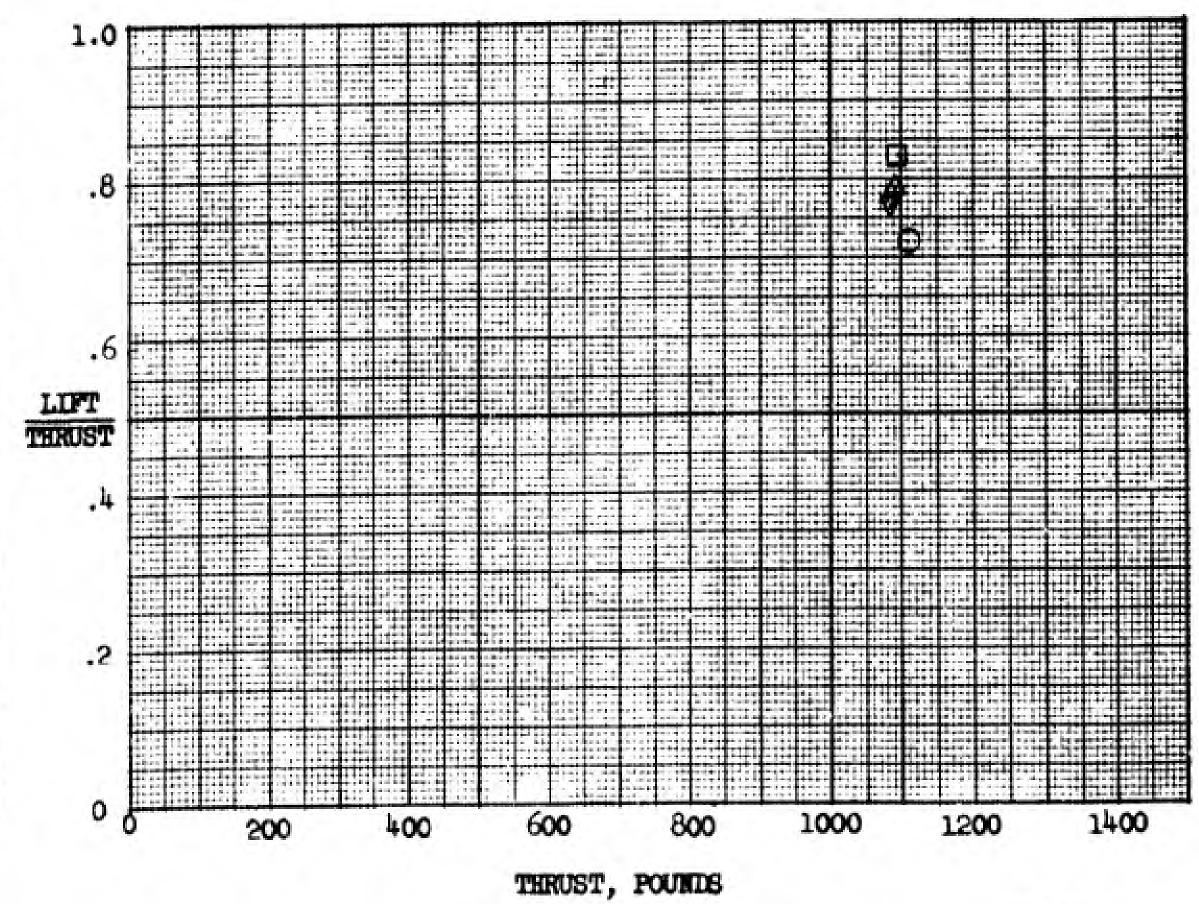












MODEL 88 BIPLANE CONFIGURATION

Figure 75

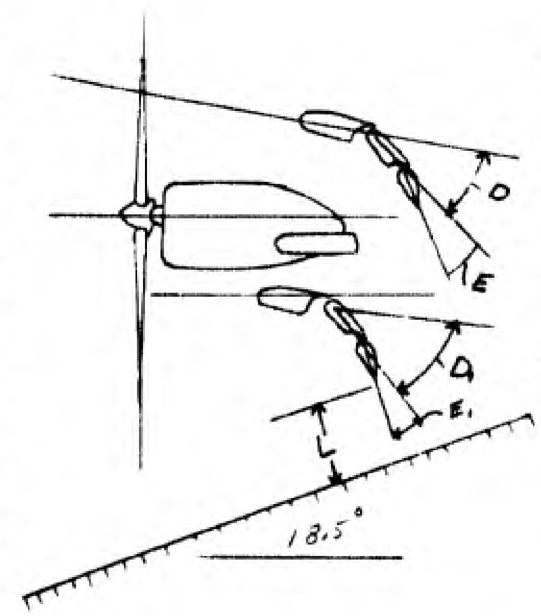
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

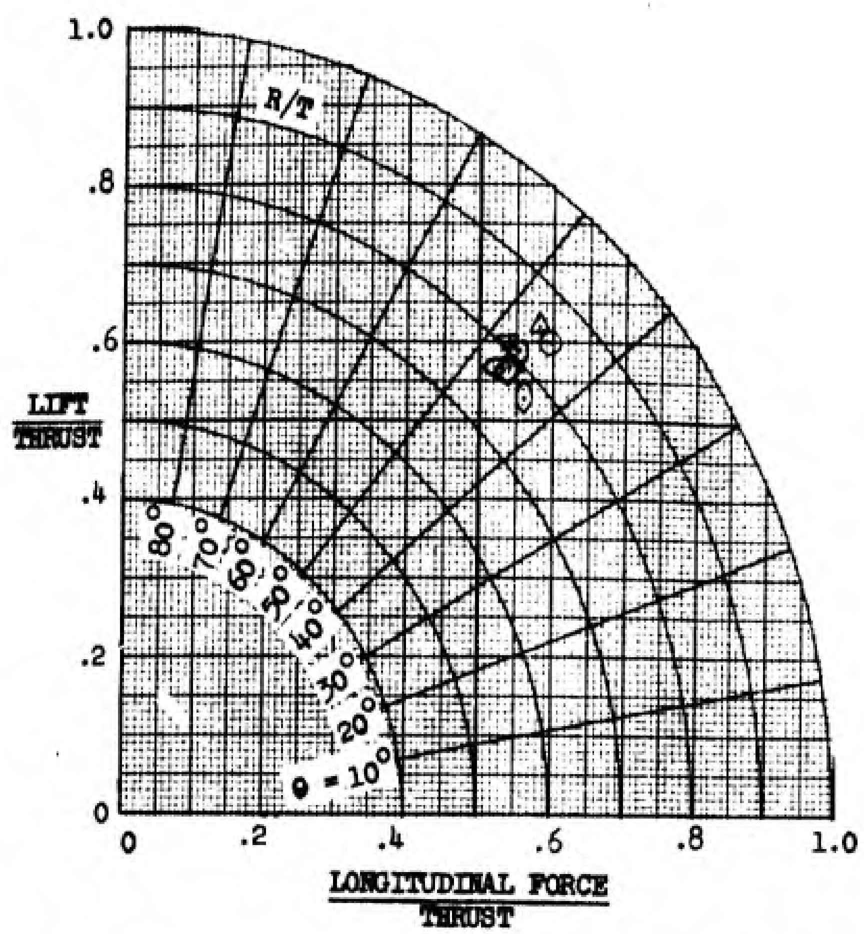
Effect of Upper and Lower Wing-Flaps Deflected Progressively

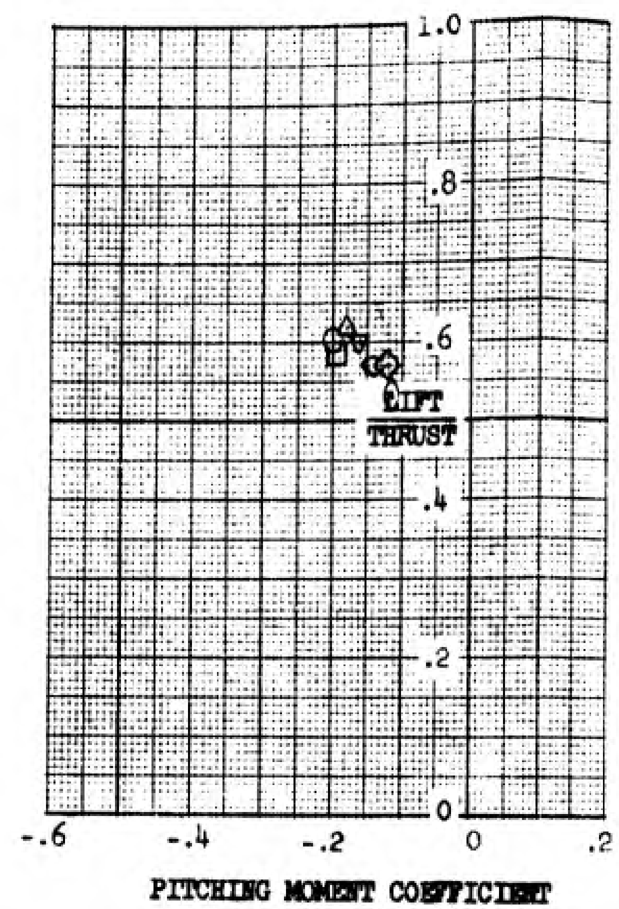
With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

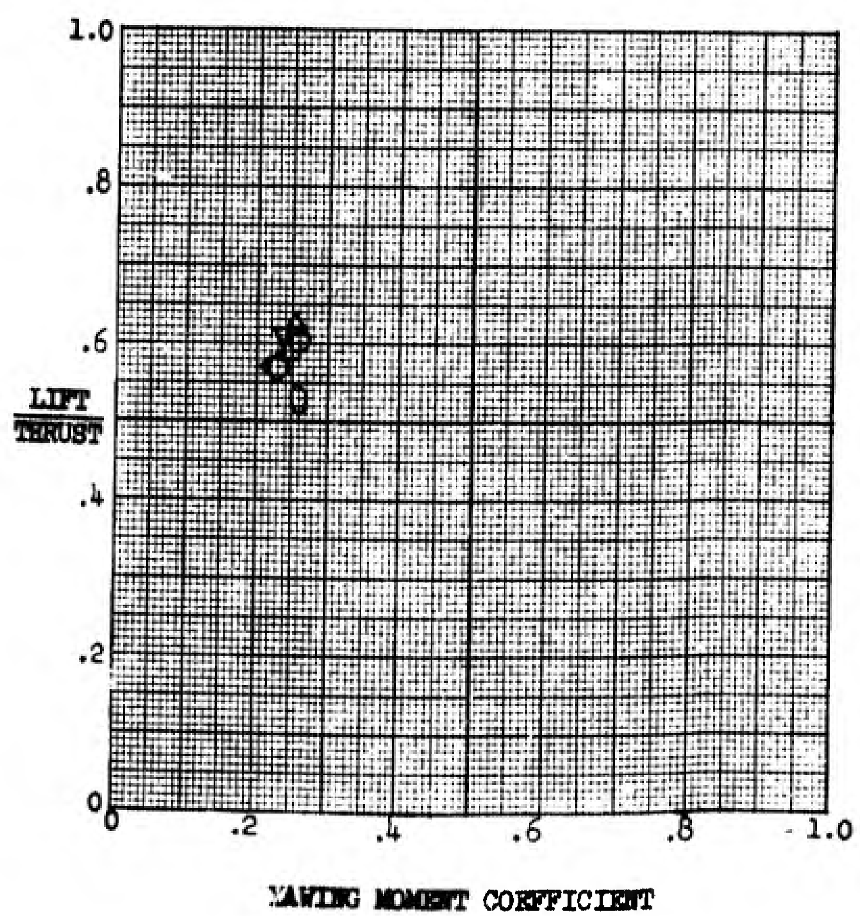
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

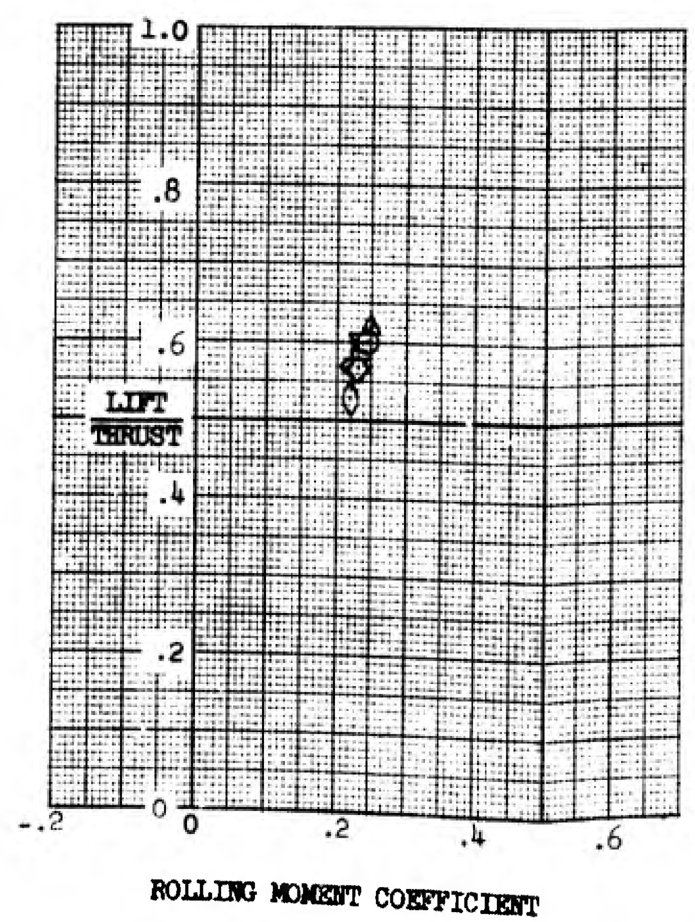
SYM	RUN	D	E	D_1	E_1	L
	B 7.1	32.50	25.00	47.50	48.00	7.50
	B 7.2	35.00	29.00	45.00	44.00	7.88
	B 7.3	37.50	33.00	42.50	40.50	8.50
	B 7.4	40.00	37.00	40.00	37.00	9.13
	B 7.5	42.50	40.50	37.50	33.00	10.00
	B 7.6	45.00	44.00	35.00	29.00	10.75
	B 7.7	47.50	48.00	32.50	25.00	11.38











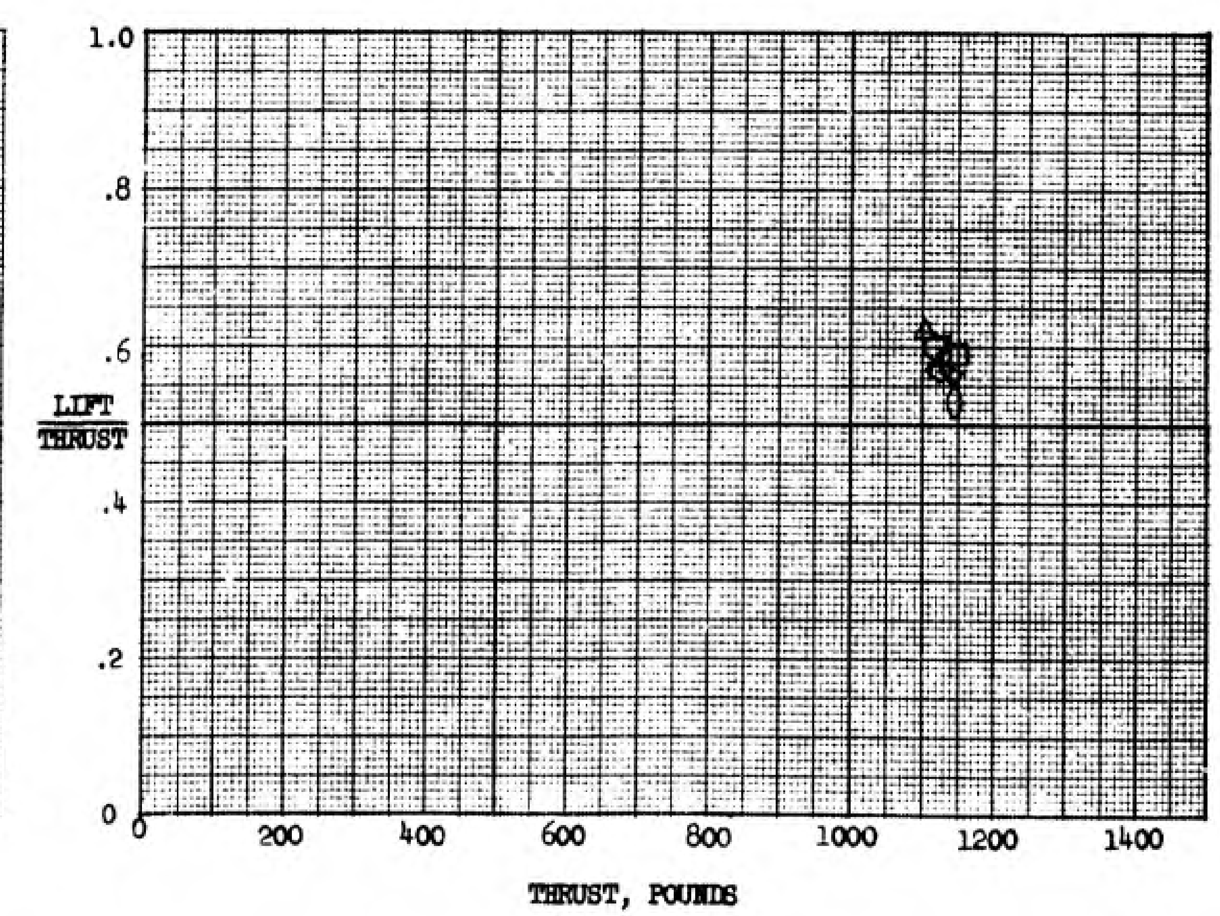


Figure 76

MODEL 88 BIPLANE CONFIGURATION

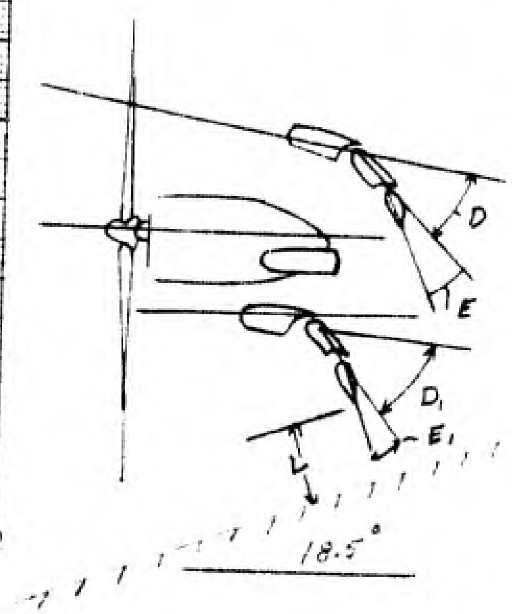
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

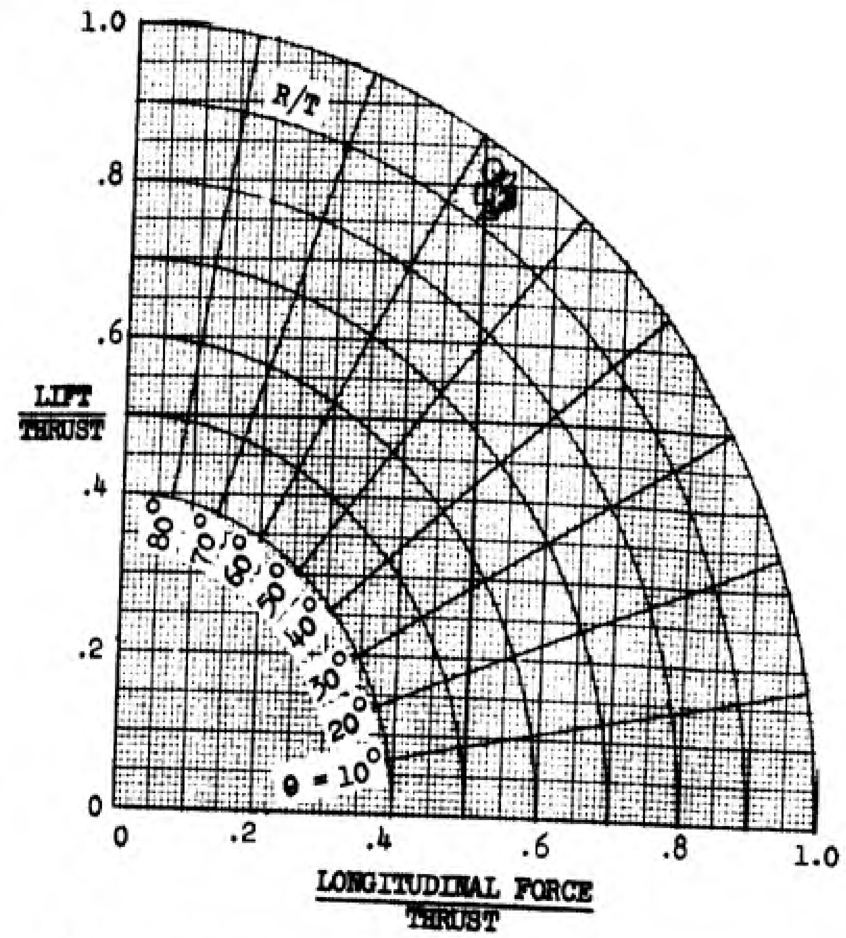
Effect of Upper and Lower Wing-Flaps Deflected Progressively

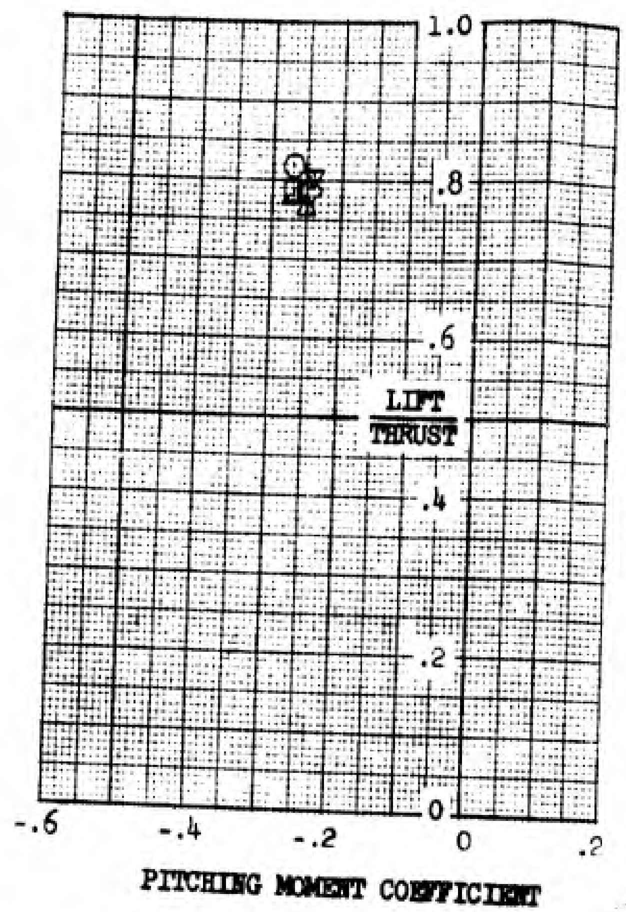
With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

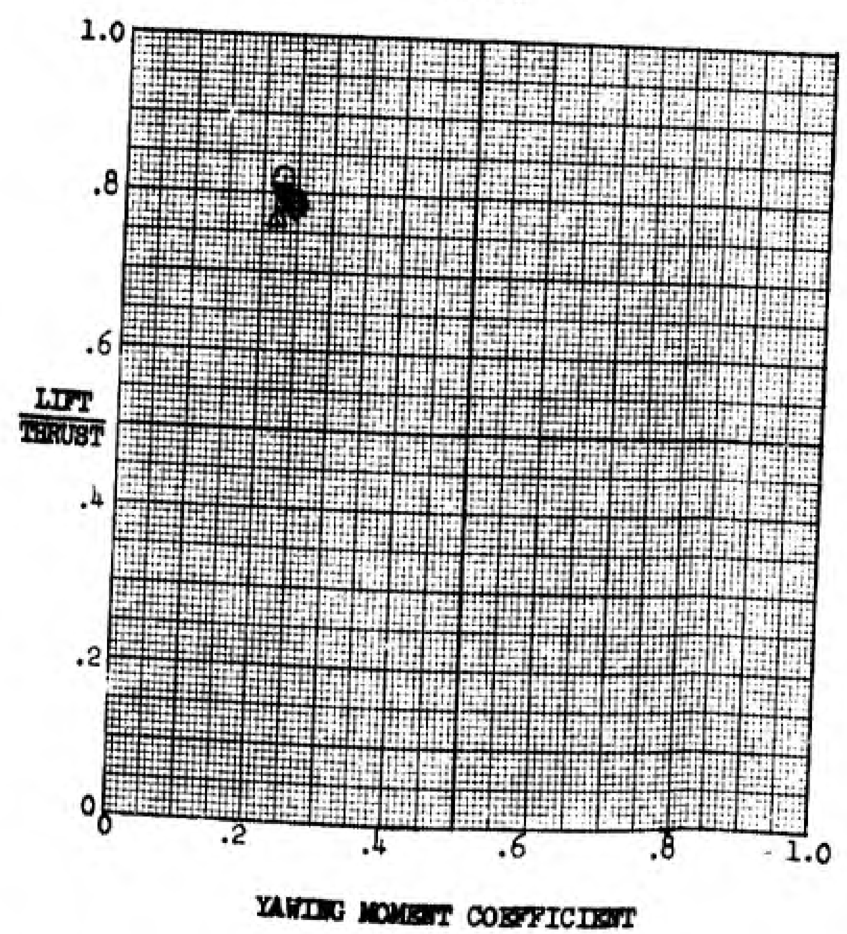
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

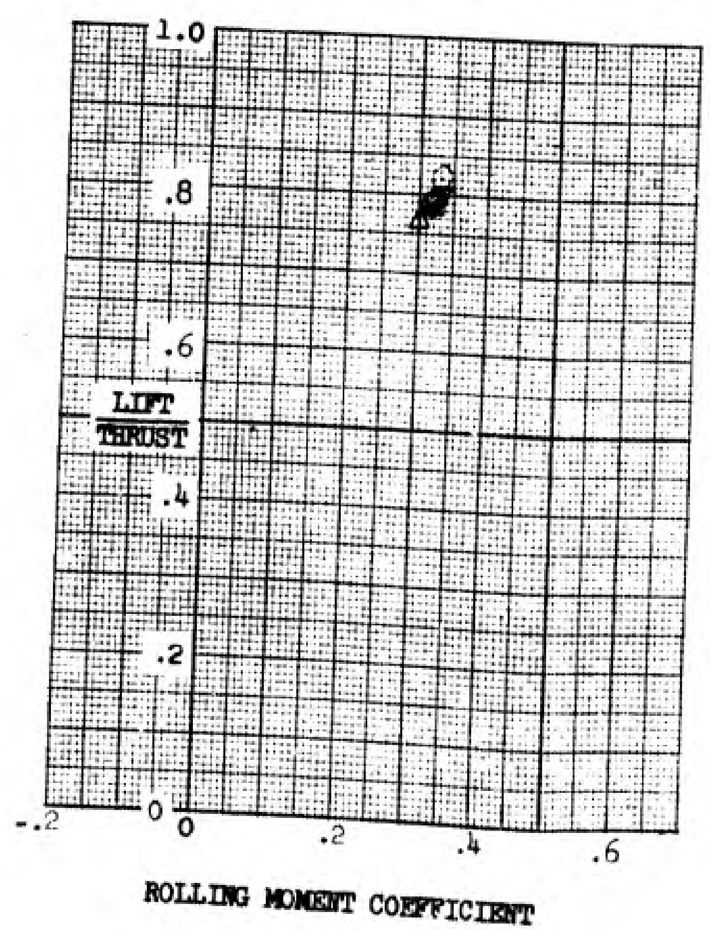
SYM	RUN	D	E	D_1	E_1	L
○	B 22.1	37.50	33.00	42.50	40.50	16.00
△	B 22.2	38.75	35.00	41.25	38.75	16.20
□	B 22.3	40.00	37.00	40.00	37.00	16.50
▽	B 22.4	41.25	38.75	38.75	35.00	17.30
◇	B 22.5	42.50	40.50	37.50	33.00	17.50
⊿	B 22.6	43.75	42.50	36.25	31.00	18.25











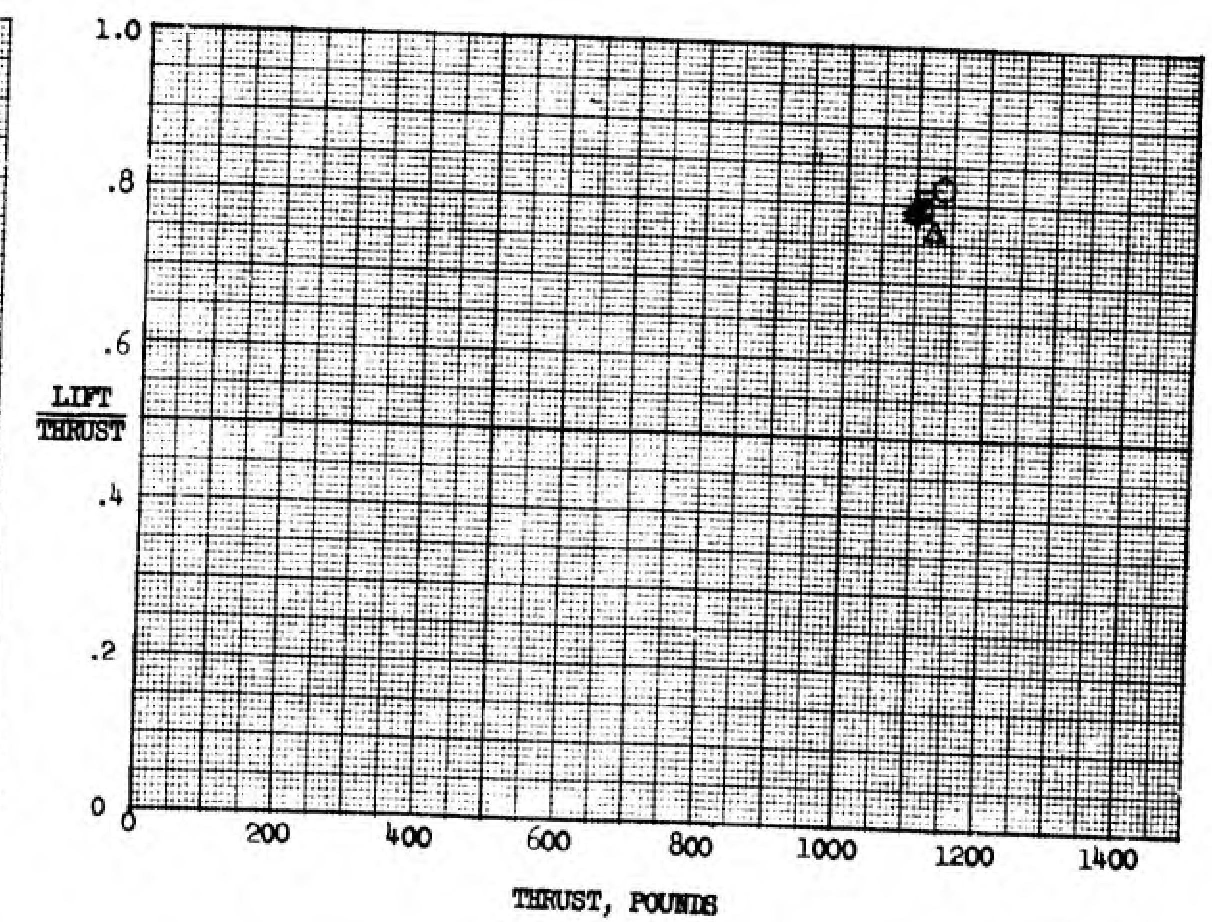


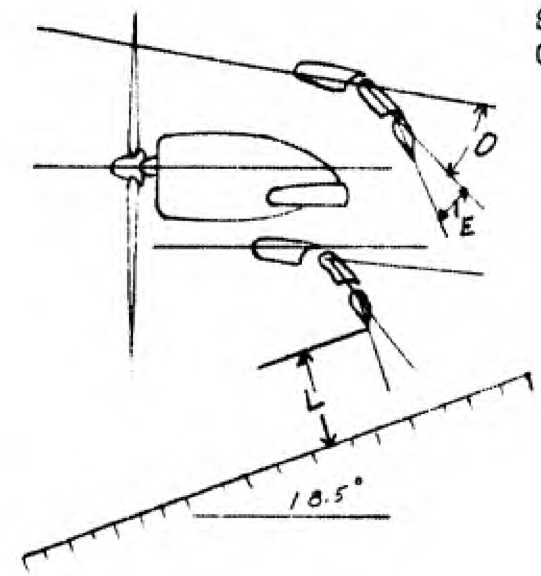
Figure 77

MODEL 88 BIPLANE CONFIGURATION

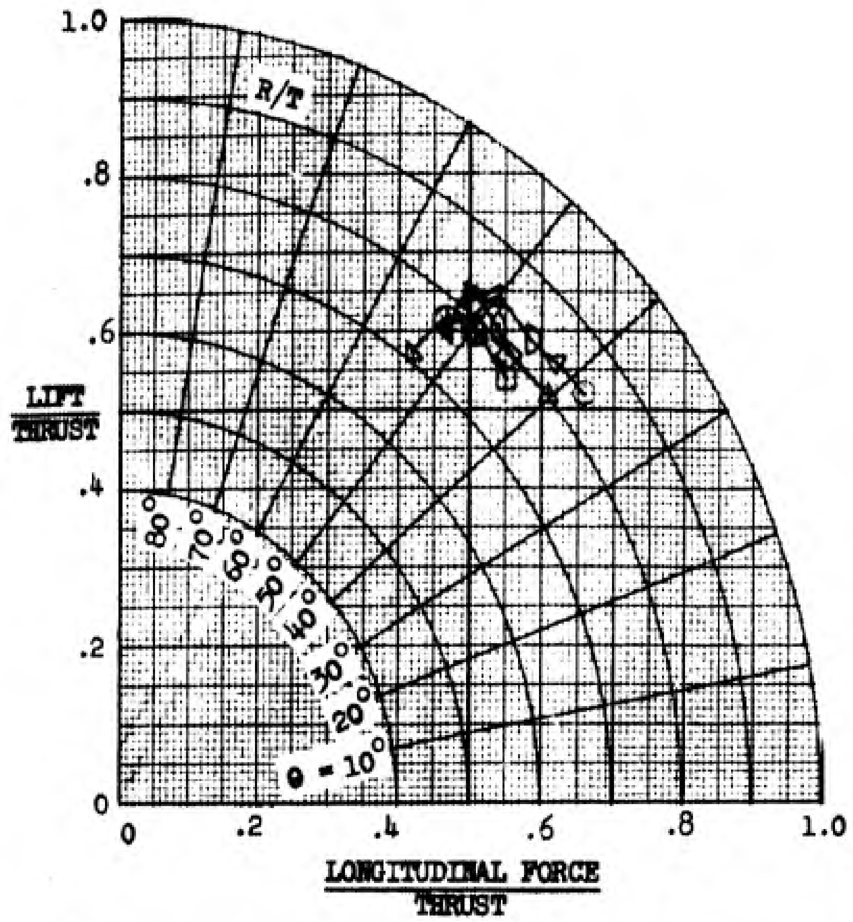
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

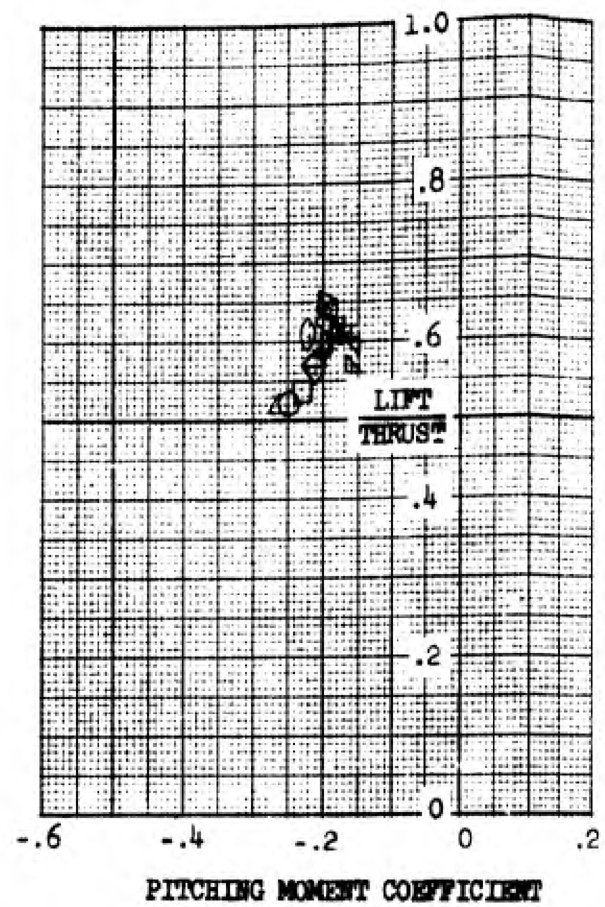
Effect of Upper Wing Angle of Attack for Several Upper Wing Flap Deflection Angles with Lower Wing at 5° Angle of Incidence

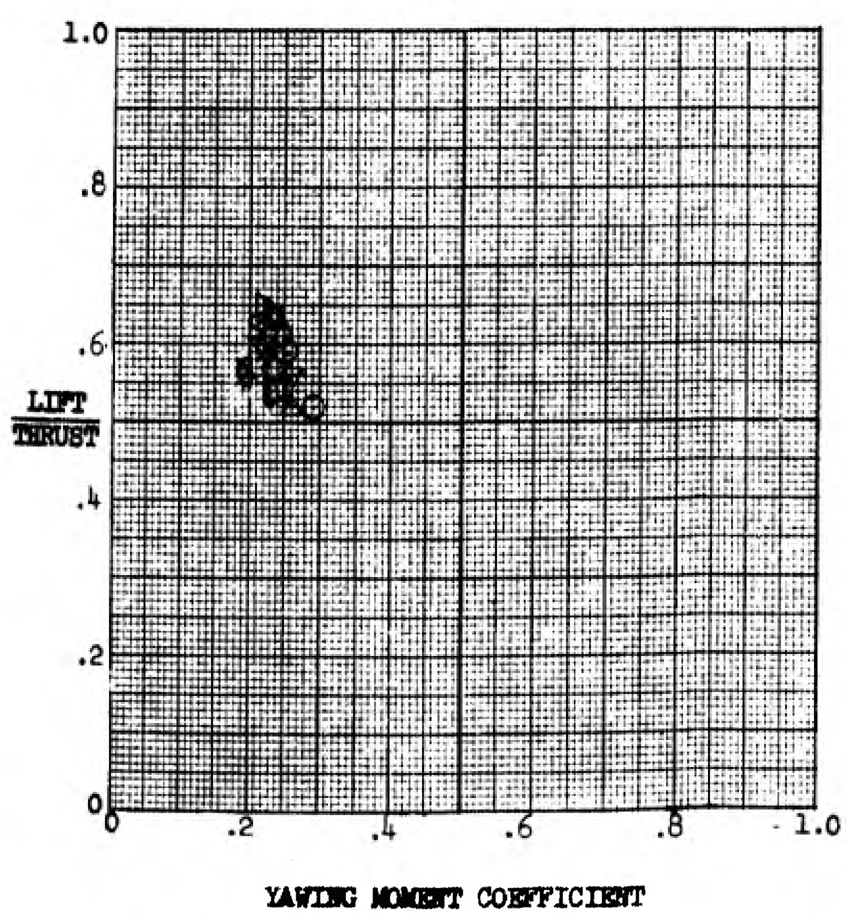
Lower wing forward flap = 50° deflection
Lower wing aft flap = 51° deflection
Gap/chord ratio = 1.10
Stagger/chord ratio = -0.30
Ground plane installed

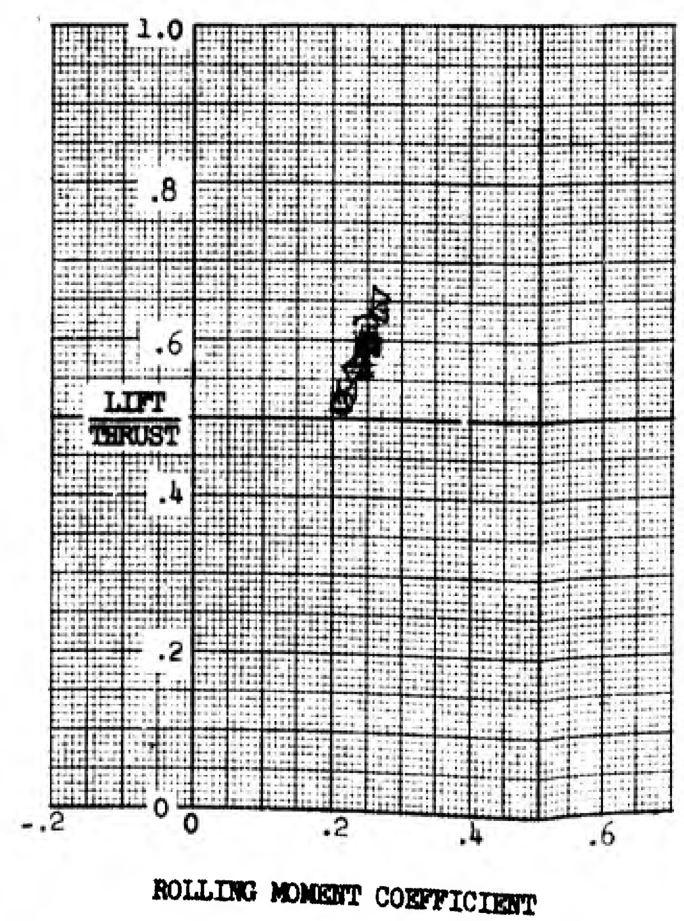


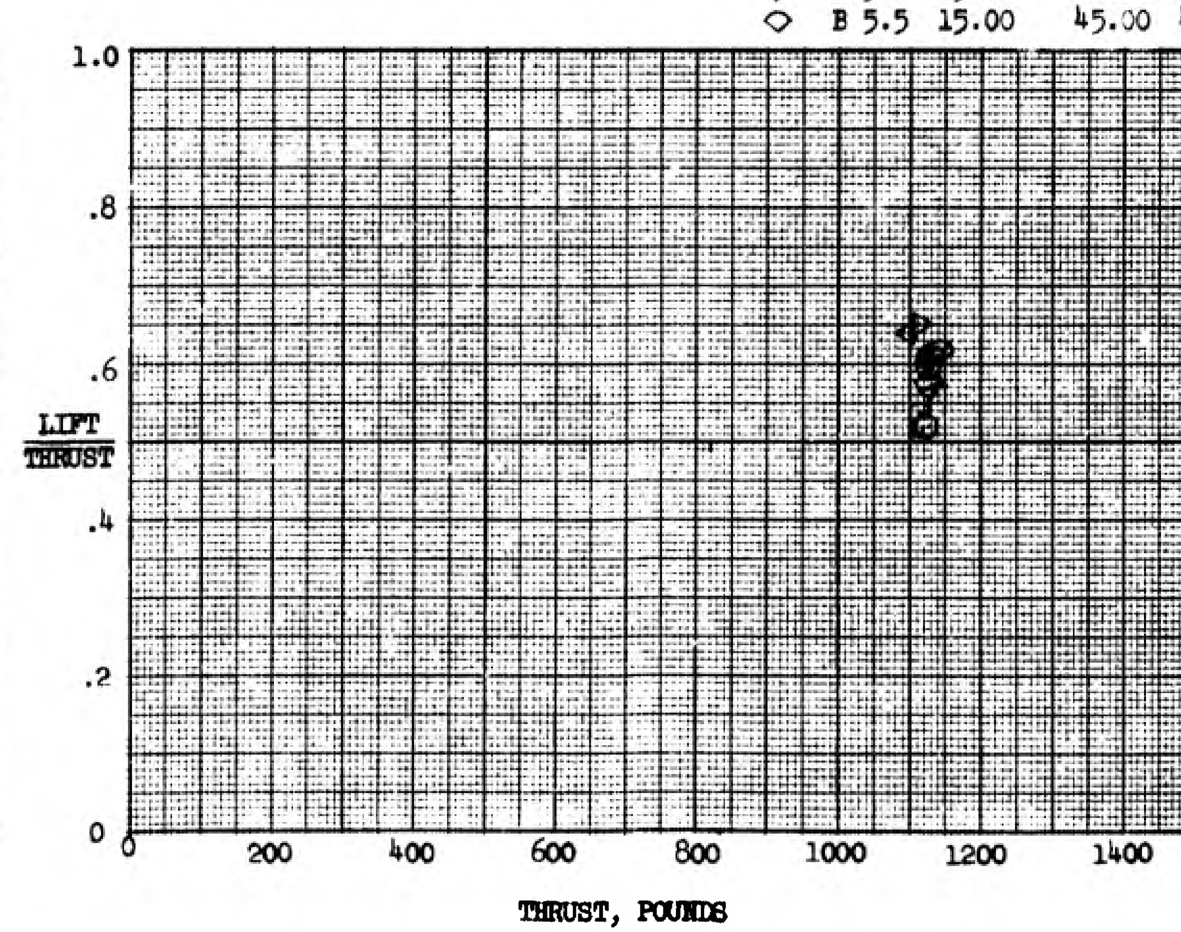
SYM	RUN	ANGLE OF INCIDENCE	D	E
○	B 1.1	5.00	35.00	29.00
∠	B 1.2	5.00	40.00	37.00
⊏	B 1.3	5.00	45.00	44.00
▽	B 2.2	10.00	35.00	29.00
◇	B 2.3	10.00	40.00	37.00
⊿	B 2.4	10.00	45.00	44.00
◸	B 3.4	25.00	35.00	29.00
◁	B 3.5	25.00	40.00	37.00
◹	B 3.6	25.00	45.00	44.00
◁	B 4.3	20.00	35.00	29.00
▷	B 4.4	20.00	40.00	37.00
⊐	B 4.5	20.00	45.00	44.00
D	B 5.3	15.00	35.00	29.00
0	B 5.4	15.00	40.00	37.00
◇	B 5.5	15.00	45.00	44.00









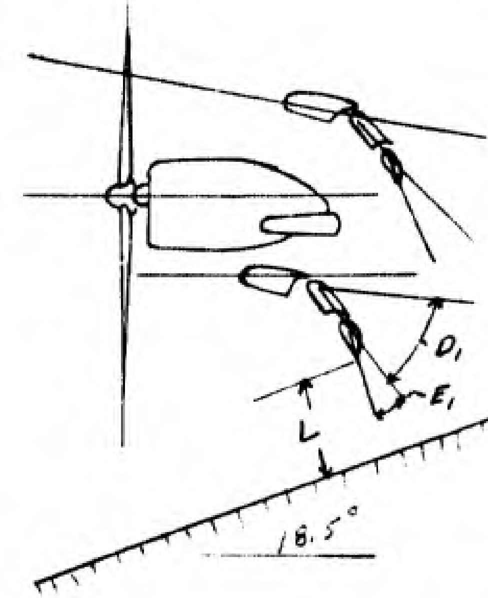


MODEL 88 BIPLANE CONFIGURATION Figure 78

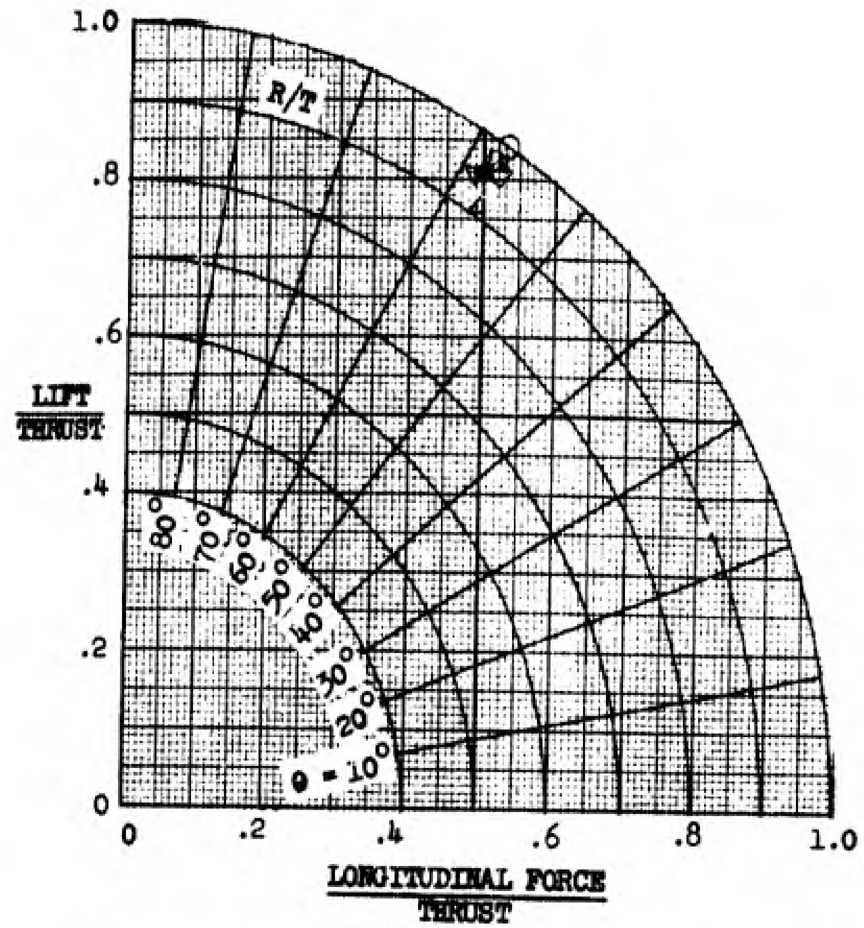
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

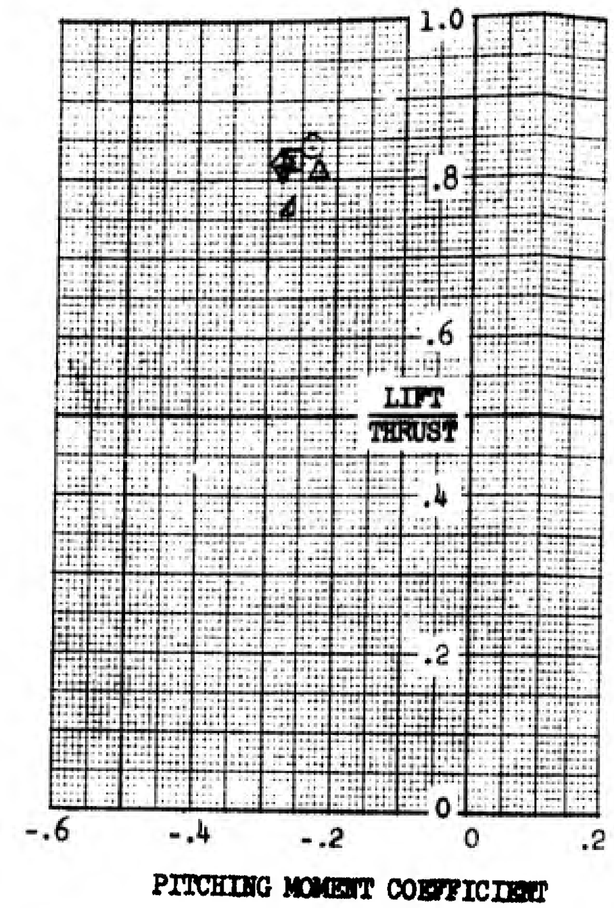
Effect of Lower Wing Angle of Attack for Several Lower Wing Flap Deflection Angles with Upper Wing at 20° Angle of Incidence

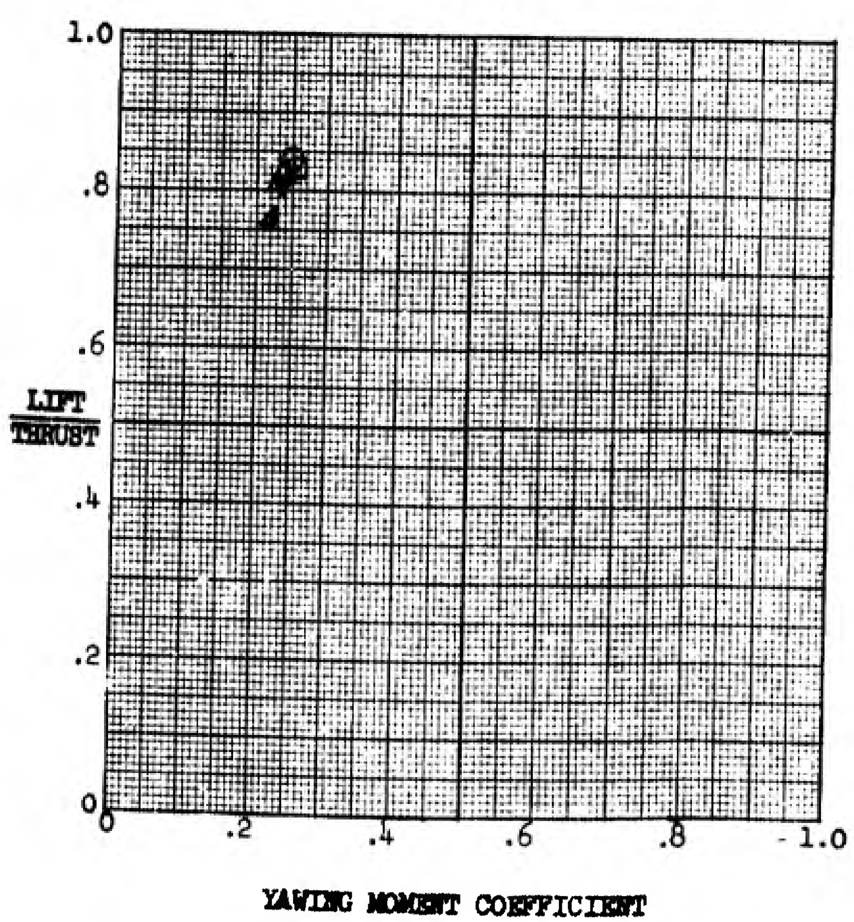
Upper wing forward flap = 42.5° deflection
Upper wing aft flap = 40.5° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

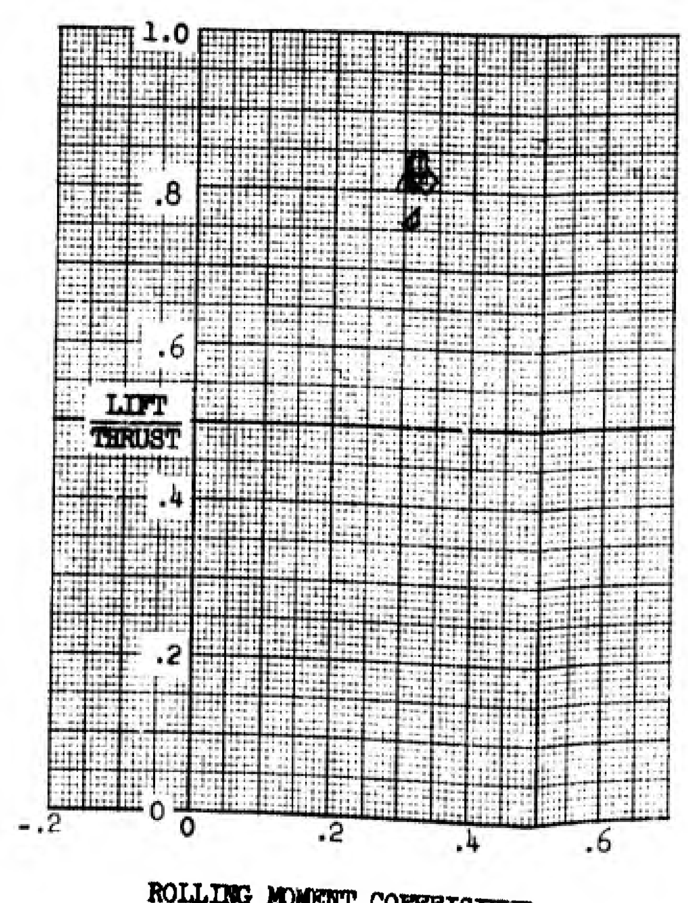


SYM	RUN	ANGLE OF INCIDENCE	D_1	E_1	L
○	B 19.2	7.5	35.00	29.00	16.75
△	B 19.3	7.5	40.00	37.00	15.50
□	B 20.2	10.0	35.00	29.00	15.75
▽	B 20.3	10.0	40.00	37.00	14.50
◇	B 21.3	12.5	35.00	29.00	14.50
◿	B 21.4	12.5	40.00	37.00	13.50









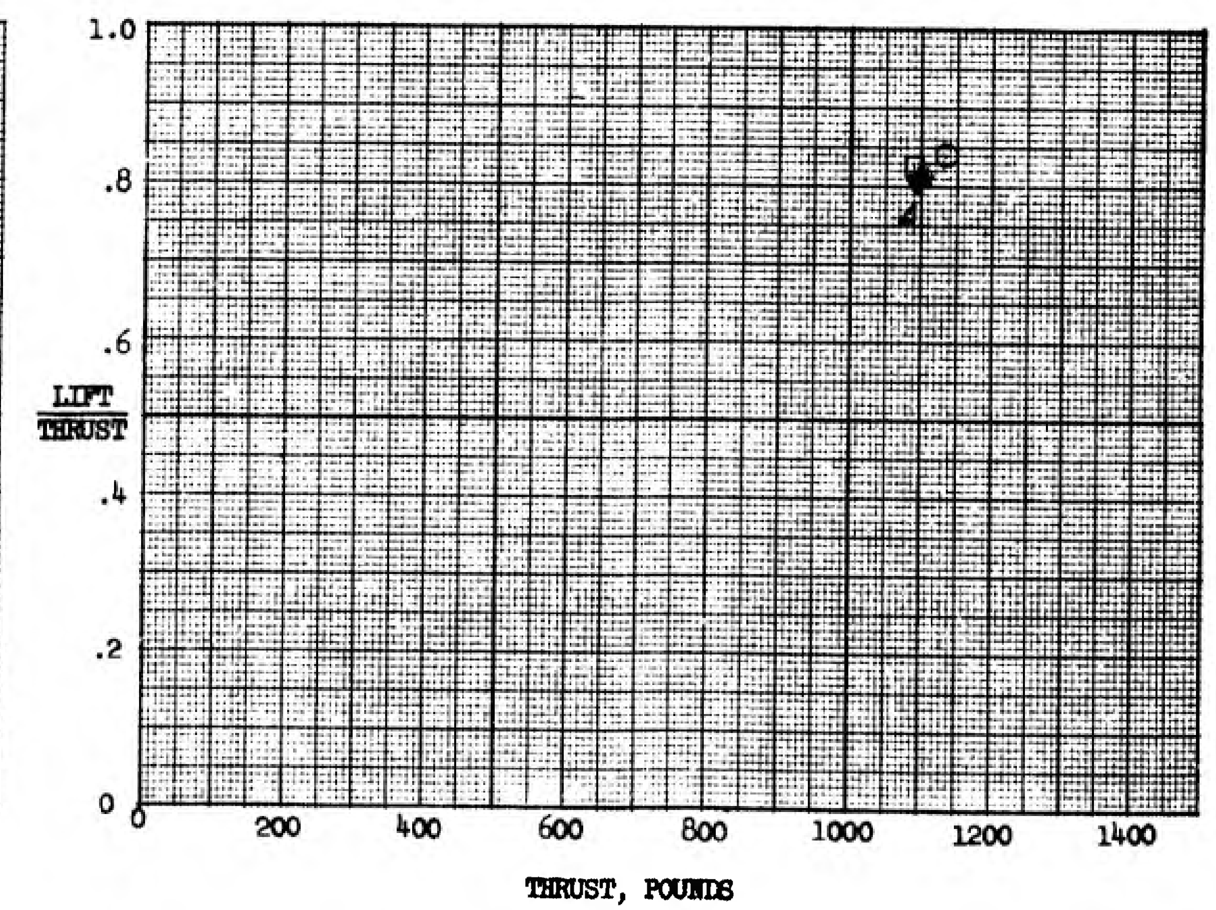


Figure 79

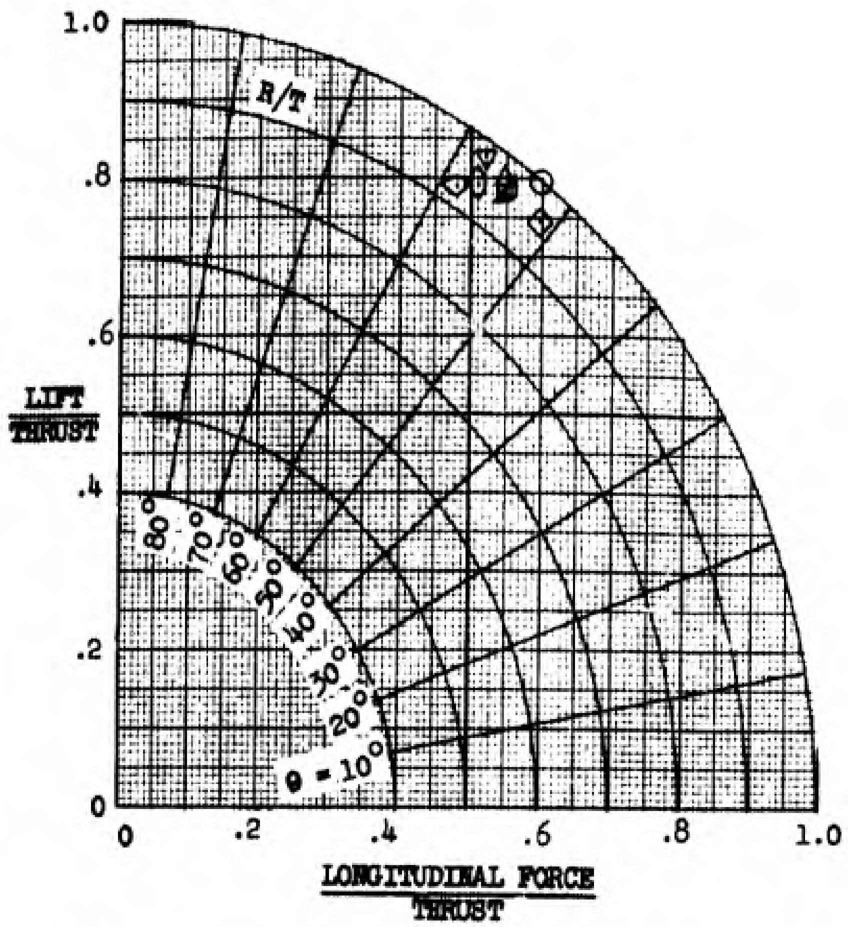
MODEL 88 BIPLANE CONFIGURATION

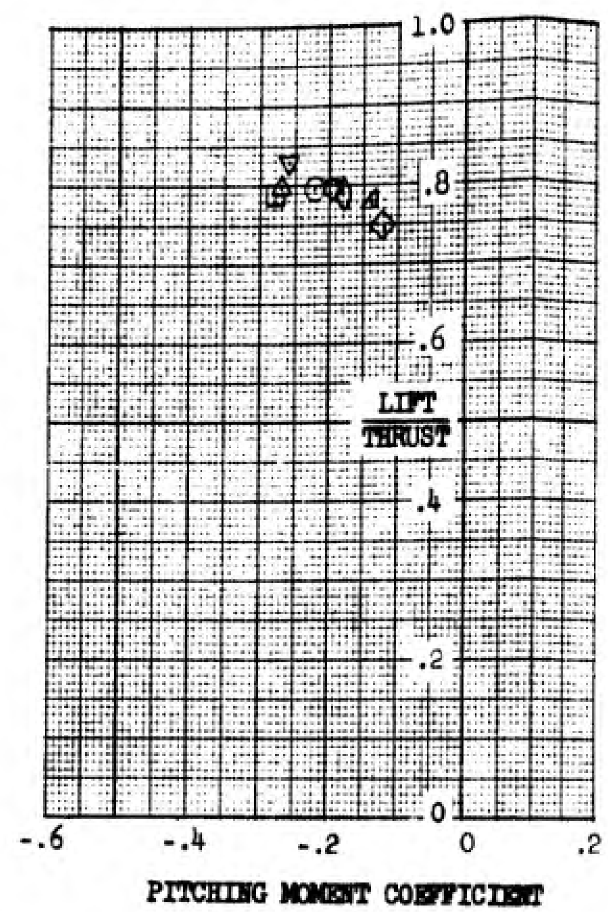
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

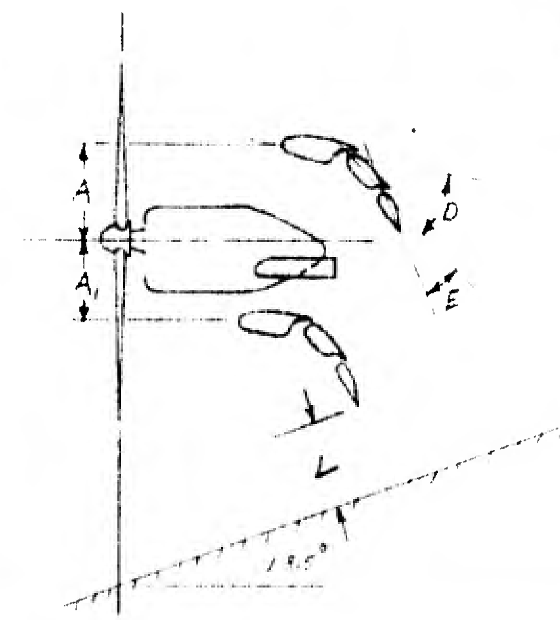
Effect of Gap/Chord Ratio Increase for Various Angles of Upper Wing-Flap Deflections With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

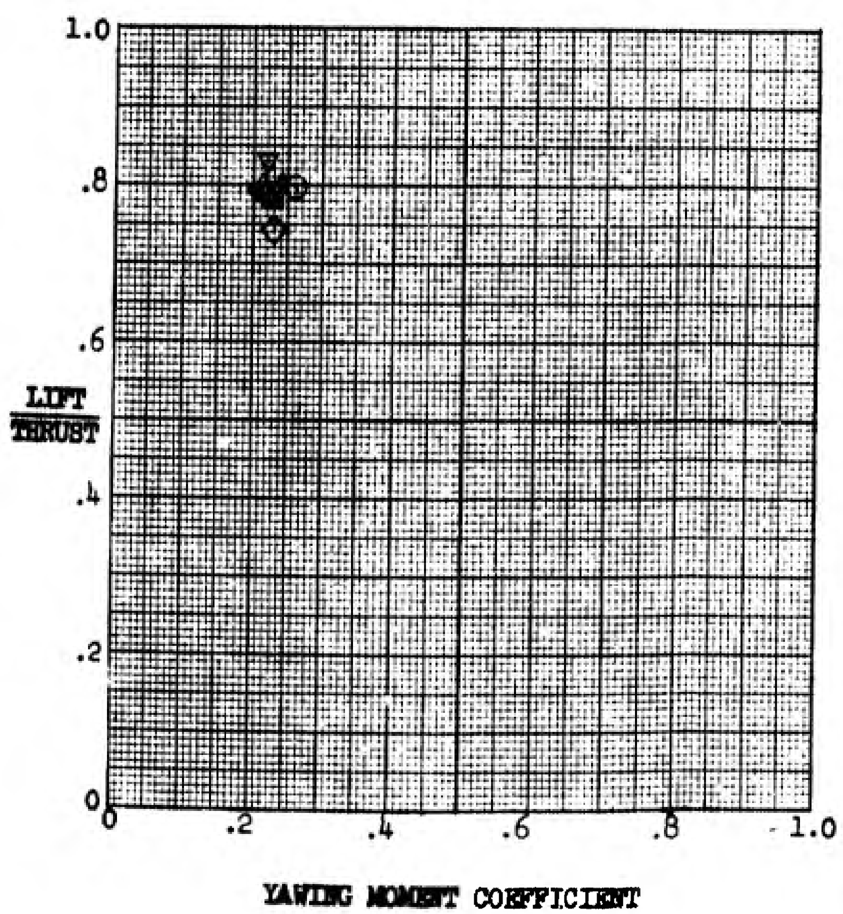
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Stagger/chord ratio = 1.53
Ground Plane installed

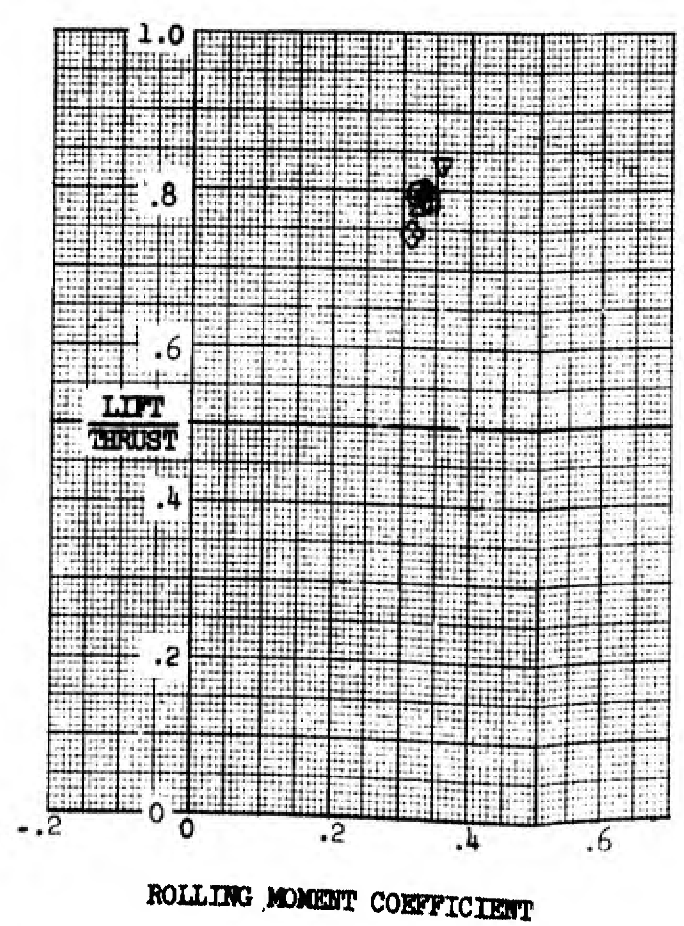
SYM	RUN	D	E	GAP/CHORD
○	B 16.1	30.00	21.50	0.695
△	B 16.2	35.00	29.00	0.695
□	B 16.3	40.00	37.00	0.695
▽	B 16.4	45.00	44.00	0.695
◇	B 17.1	30.00	21.50	0.81
⊿	B 17.2	35.00	29.00	0.81
)	B 17.3	40.00	37.00	0.81
◇	B 17.4	45.00	44.00	0.81

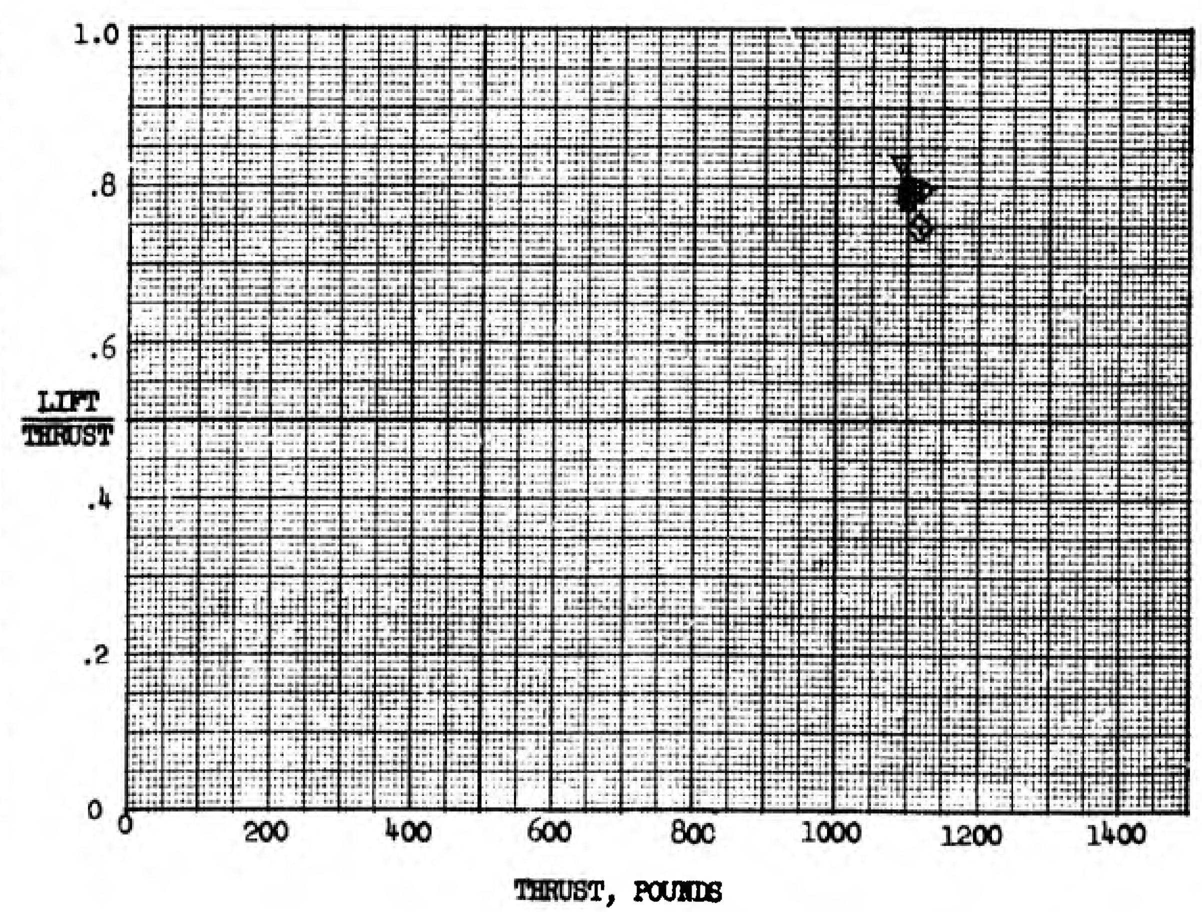












MODEL 88 BIPLANE CONFIGURATION

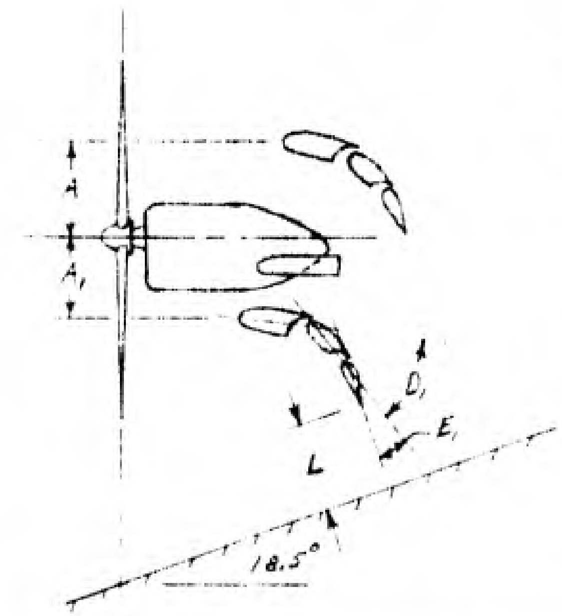
Figure 80

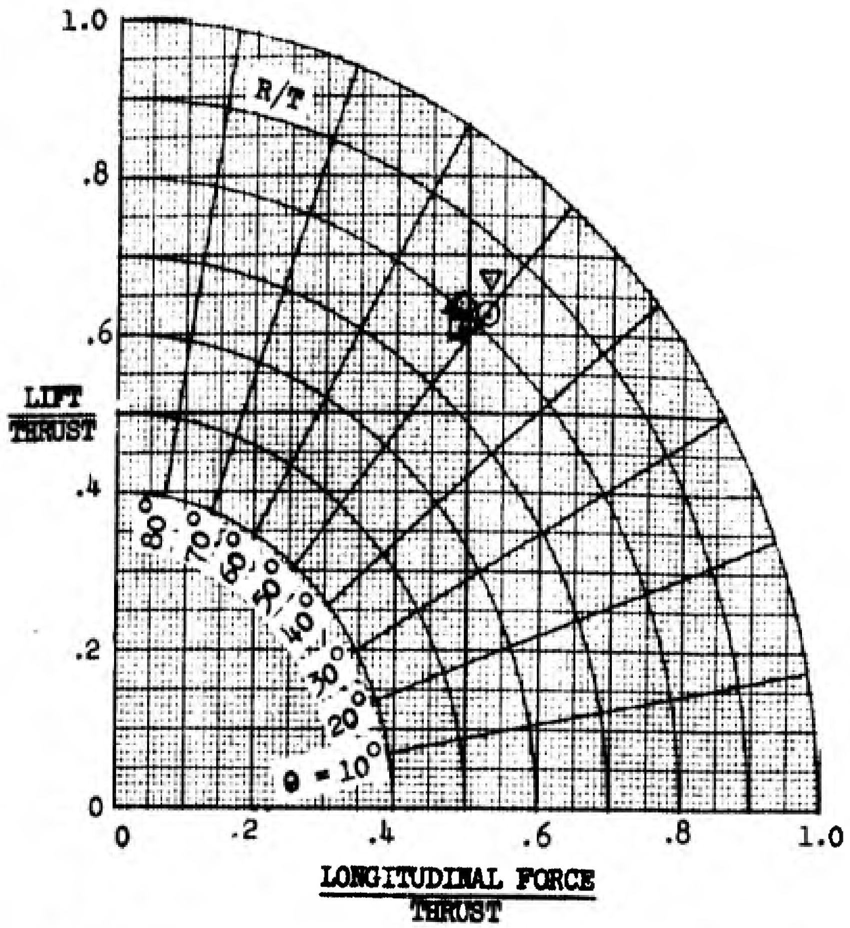
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

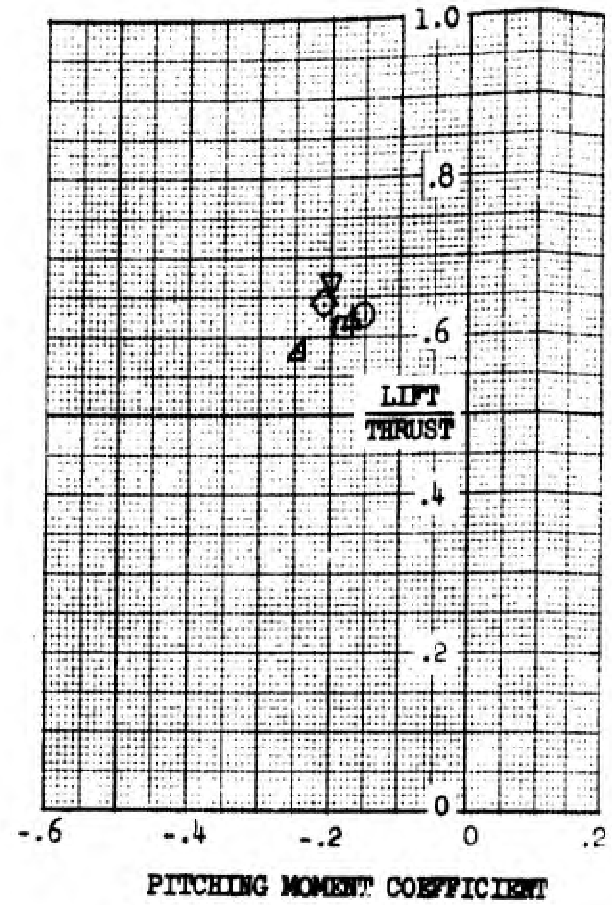
Effect of Gap/Chord Ratio Decrease for Various Angles Of Lower Wing-Flap Deflections with Upper Wing at 20° And Lower Wing at 5° Angle of Incidence

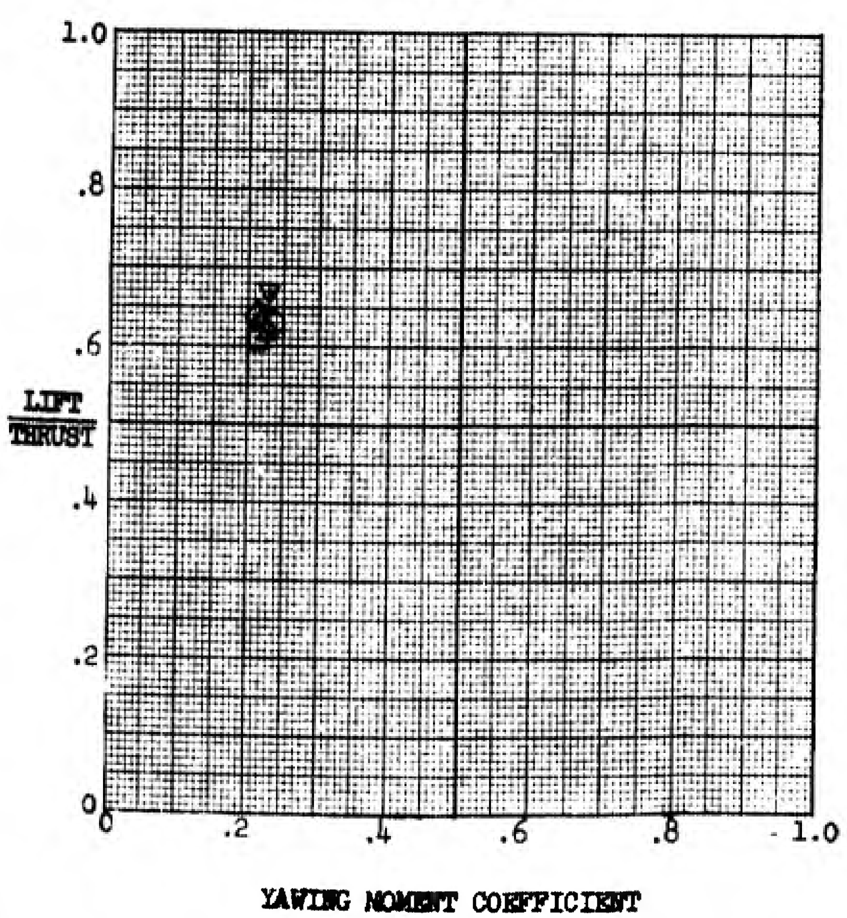
Upper wing forward flap = 40° deflection
Upper wing aft flap = 37° deflection
Stagger/chord ratio = -0.30 to -0.32
Ground plane installed

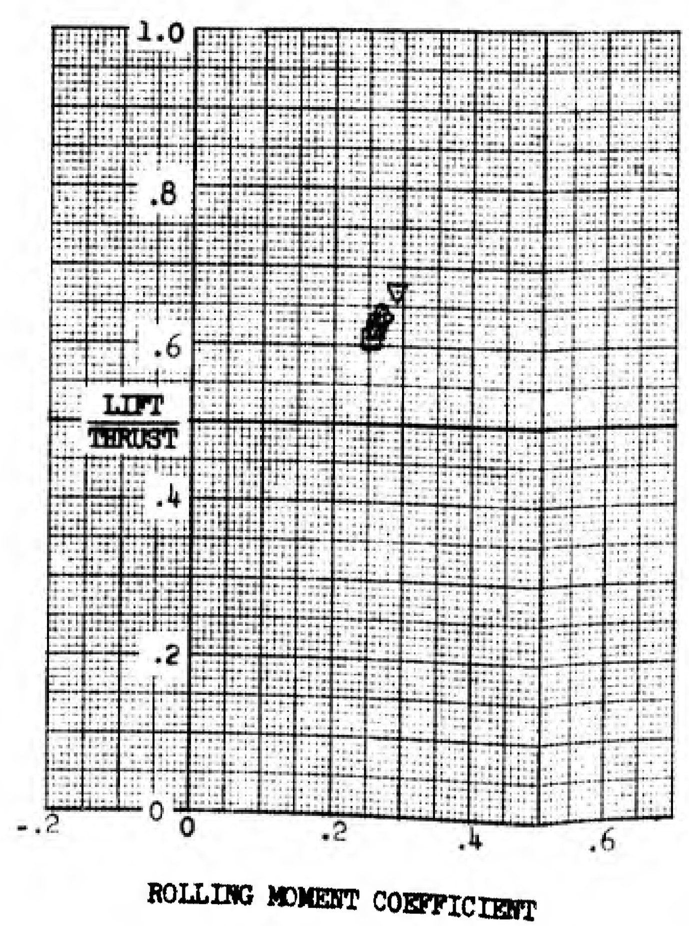
SYM	RUN	D_1	E_1	L	GAP/CHORD
◯	B 6.1	40.00	37.00	9.00	1.10
△	B 6.2	45.00	44.00	7.88	1.10
□	B 6.3	50.00	51.00	7.38	1.10
▽	B 8.2	40.00	37.00	14.38	0.89
◇	B 8.3	45.00	44.00	13.25	0.89
◿	B 8.4	50.00	51.00	13.00	0.89











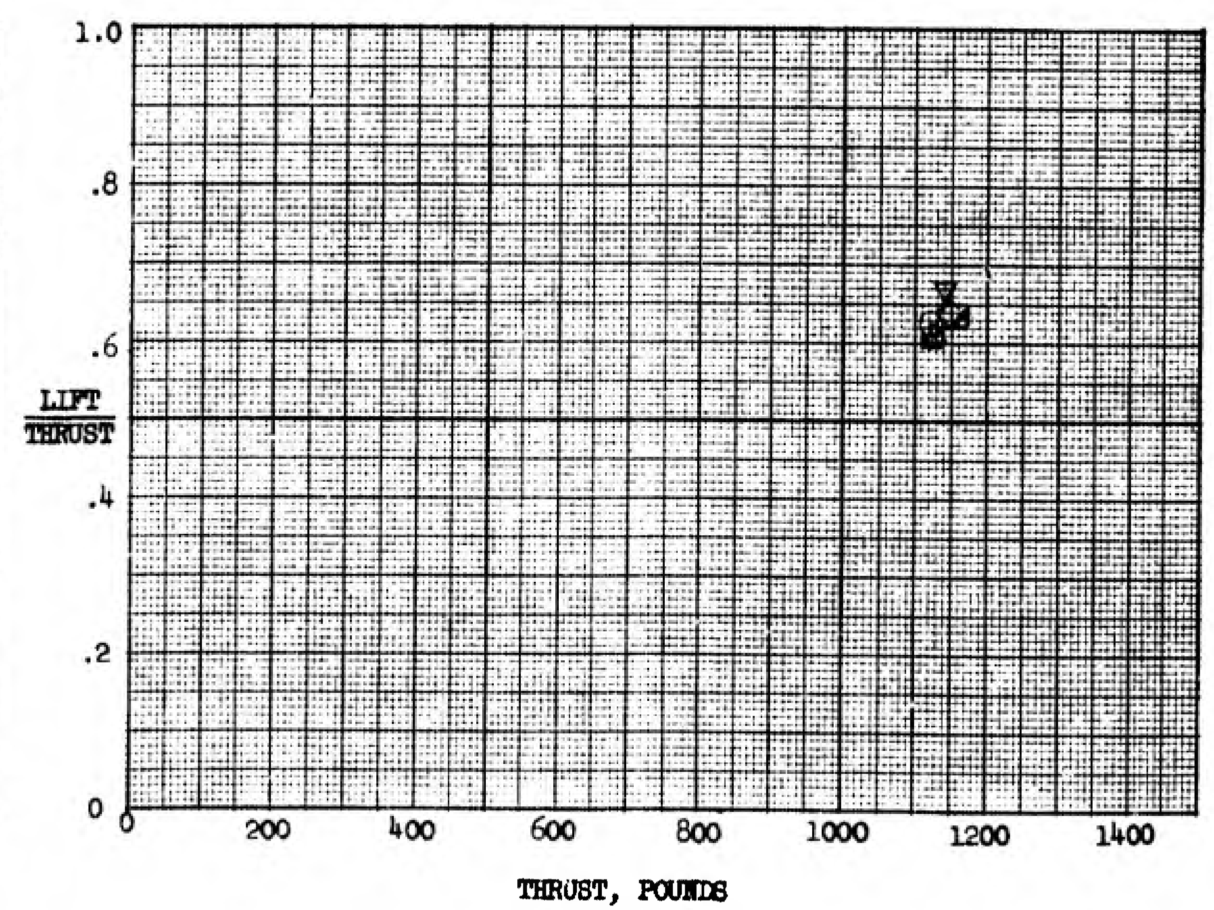


Figure 81

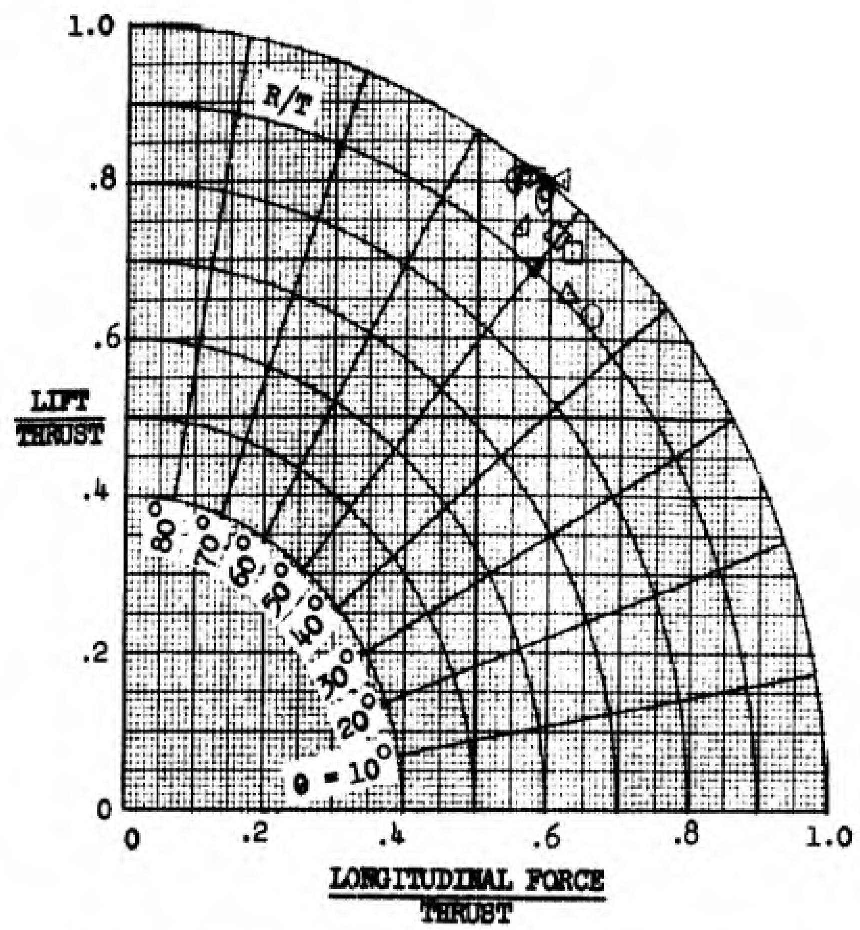
MODEL 88 BIPLANE CONFIGURATION

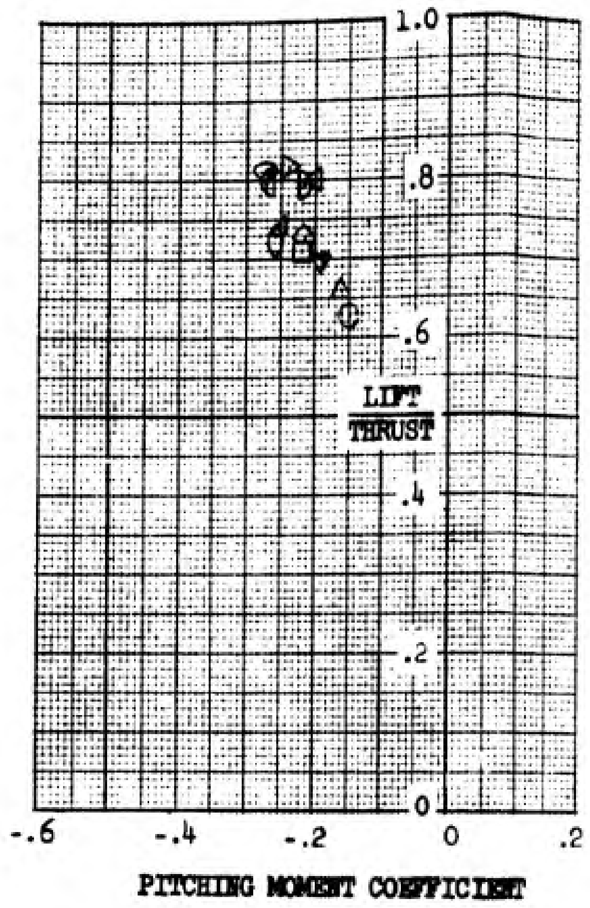
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

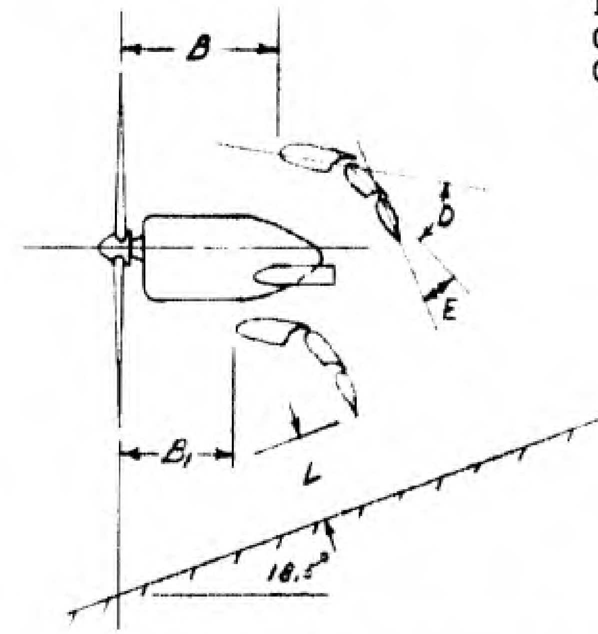
Effect of Stagger/Chord Ratio Negative Increase for Two Angles

Of Upper Wing-Flap Deflection with Upper Wing at 20°

And Lower Wing at 5° Angle of Incidence

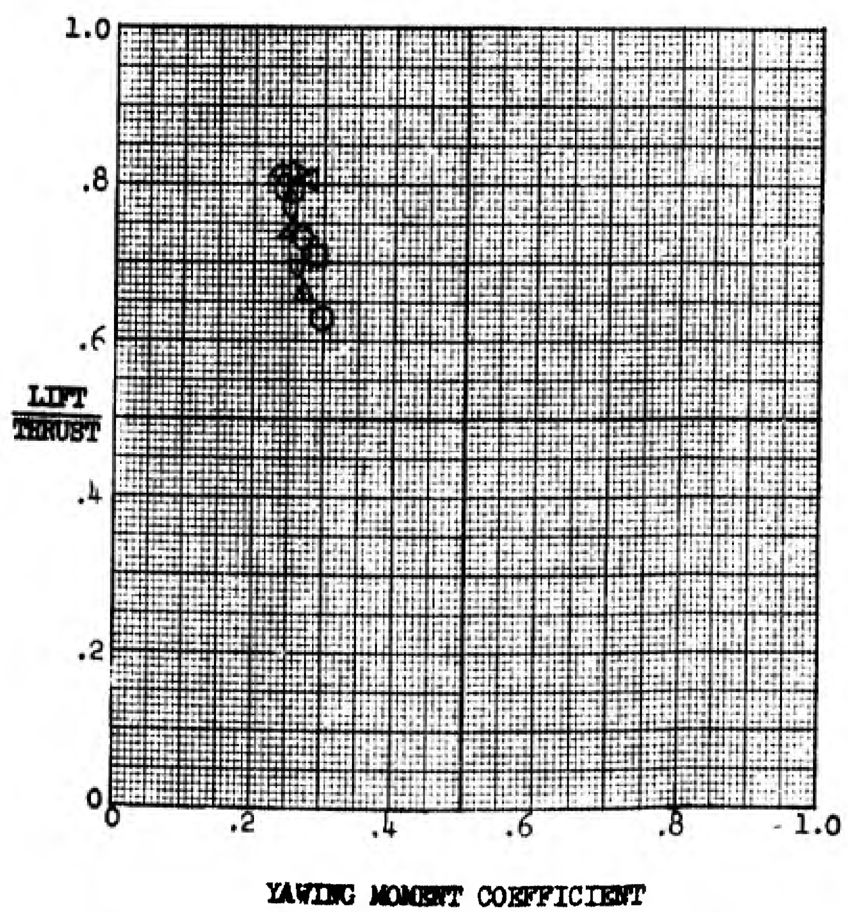


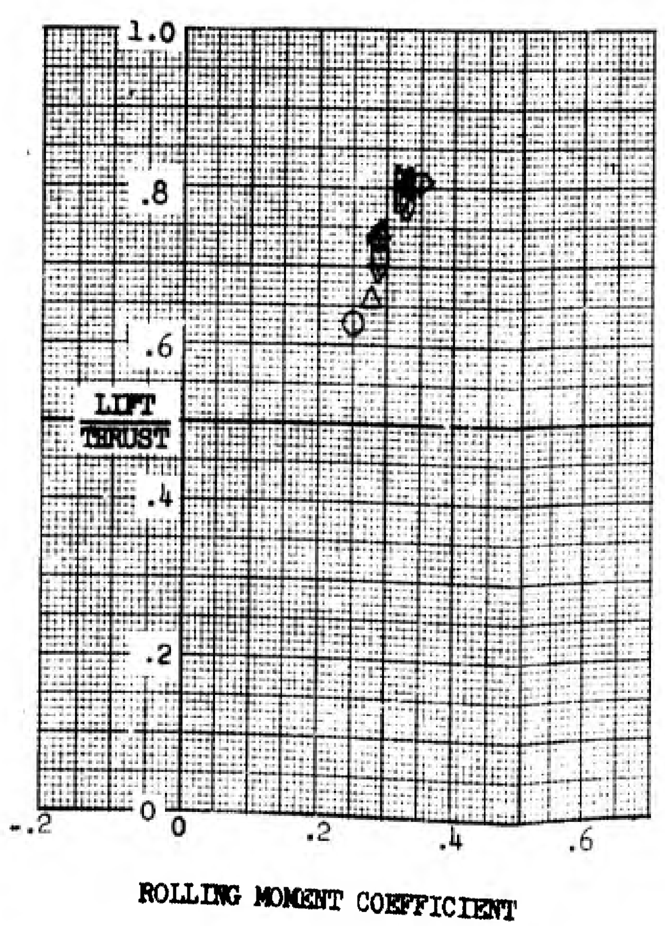


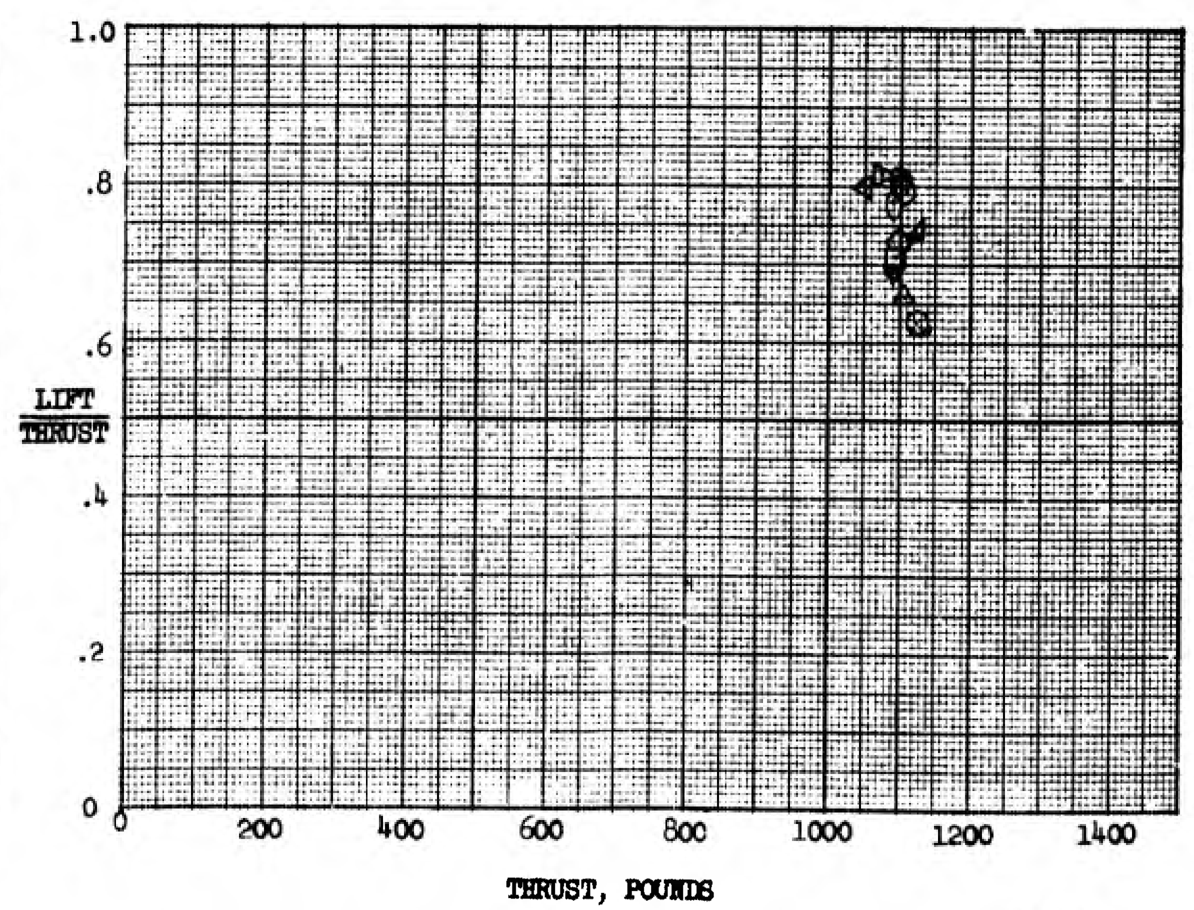


Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.70 to 0.695
Ground plane installed

SYM	RUN	D	E	STAGGER/CHORD
○	B 12.1	30.00	21.50	-0.31
△	B 12.2	35.00	29.00	-0.31
□	B 13.1	30.00	21.50	-0.66
▽	B 13.2	35.00	29.00	-0.66
◇	B 14.1	30.00	21.50	-0.945
◺	B 14.2	35.00	29.00	-0.945
◁	B 15.1	30.00	21.50	-1.24
▷	B 15.2	35.00	29.00	-1.24
D	B 16.1	30.00	21.50	-1.53
Ɑ	B 16.2	35.00	29.00	-1.53
⬯	B 18.1	30.00	21.50	-1.82
◇	B 18.2	35.00	29.00	-1.82







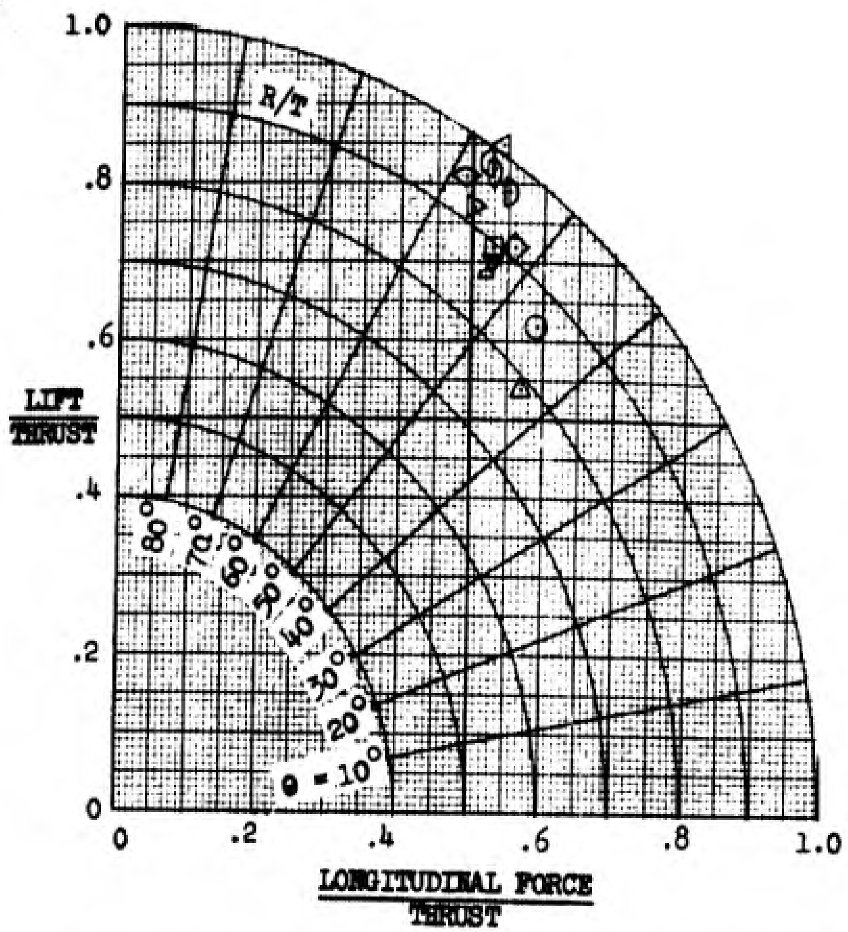
MODEL 88 BIPLANE CONFIGURATION

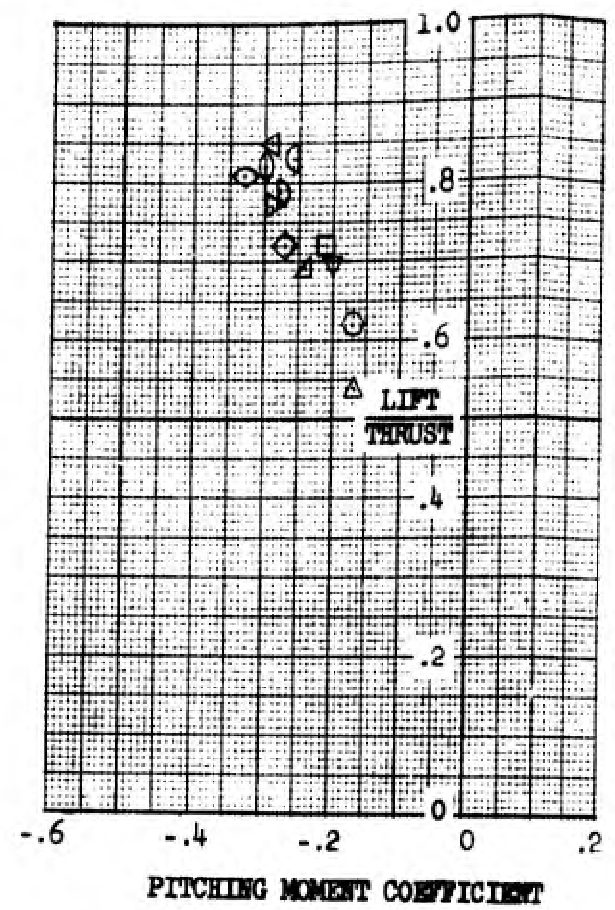
Figure 82

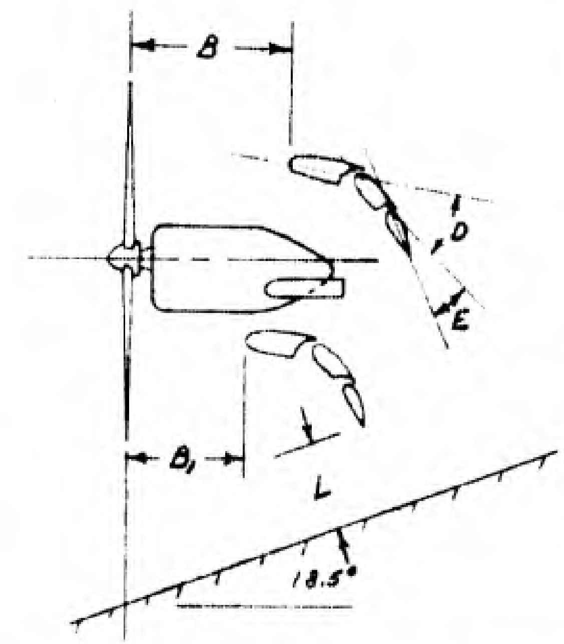
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Stagger/Chord Ratio Negative Increase for Two Angles Of Upper Wing-Flap Deflection with Upper Wing at 20°

And Lower Wing at 5° Angle of Incidence

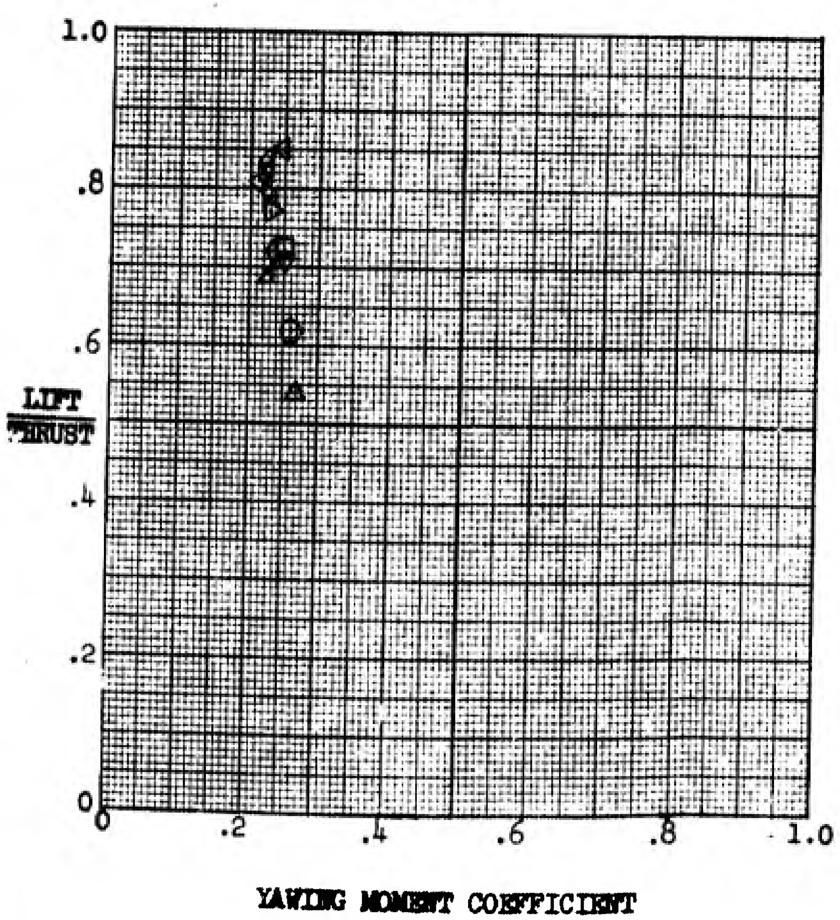


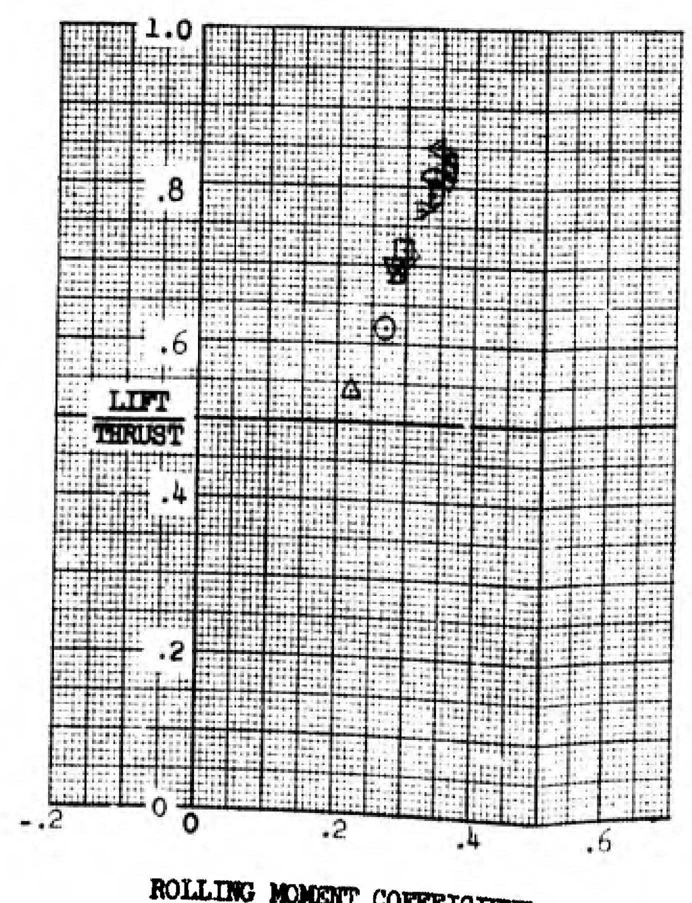




Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.70 to 0.695
Ground plane installed

SYM	RUN	D	E	STAGGER/CHORD
○	B 12.3	40.00	37.00	-0.31
⊥	B 12.4	45.00	44.00	-0.31
□	B 13.3	40.00	37.00	-0.66
∨	B 13.4	45.00	44.00	-0.66
◇	B 14.3	40.00	37.00	-0.945
◿	B 14.4	45.00	44.00	-0.945
<	B 15.3	40.00	37.00	-1.24
>	B 15.4	45.00	44.00	-1.24
D	B 16.3	40.00	37.00	-1.53
◖	B 16.4	45.00	44.00	-1.53
◯	B 18.3	40.00	37.00	-1.82
◇	B 18.4	45.00	44.00	-1.82





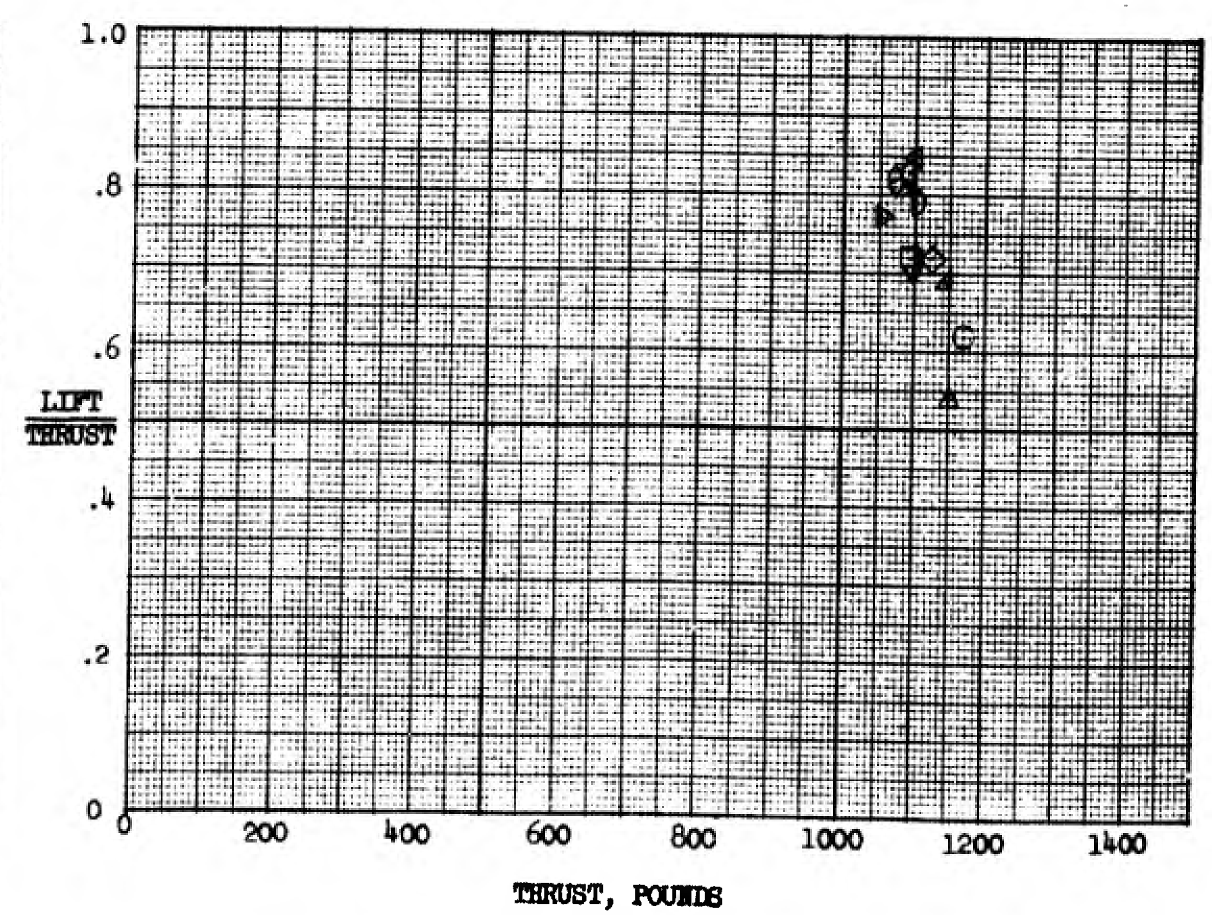


Figure 83

MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Effect of Gap/Chord Ratio Decrease and Stagger/Chord Ratio

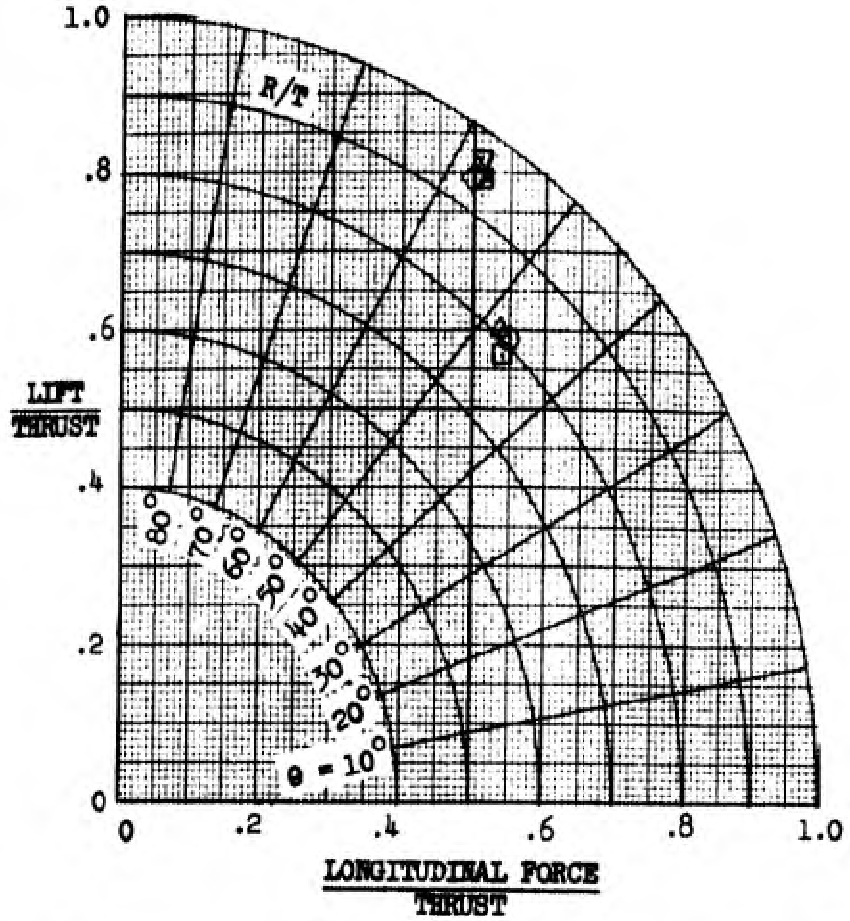
Negative Increase for Various Flap Deflection Angles of Upper and Lower Wing-Flaps

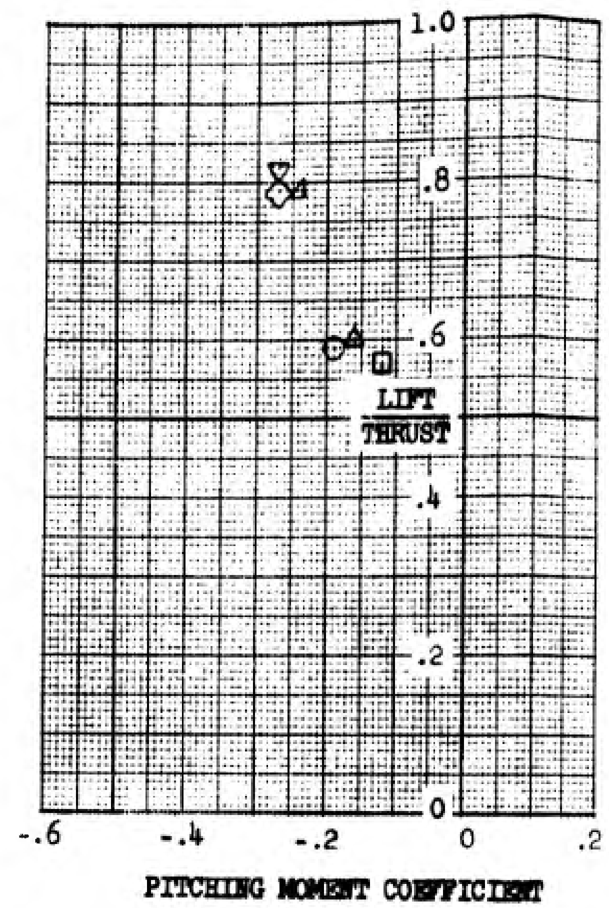
Deflecting Progressively with Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

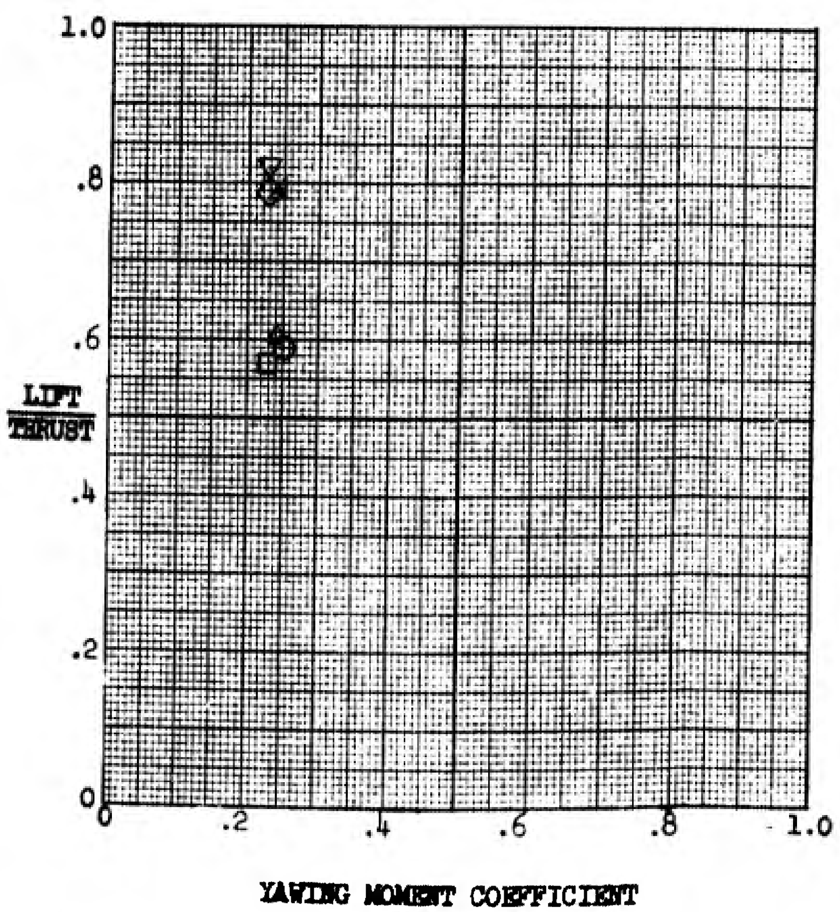
Ground Plane Installed

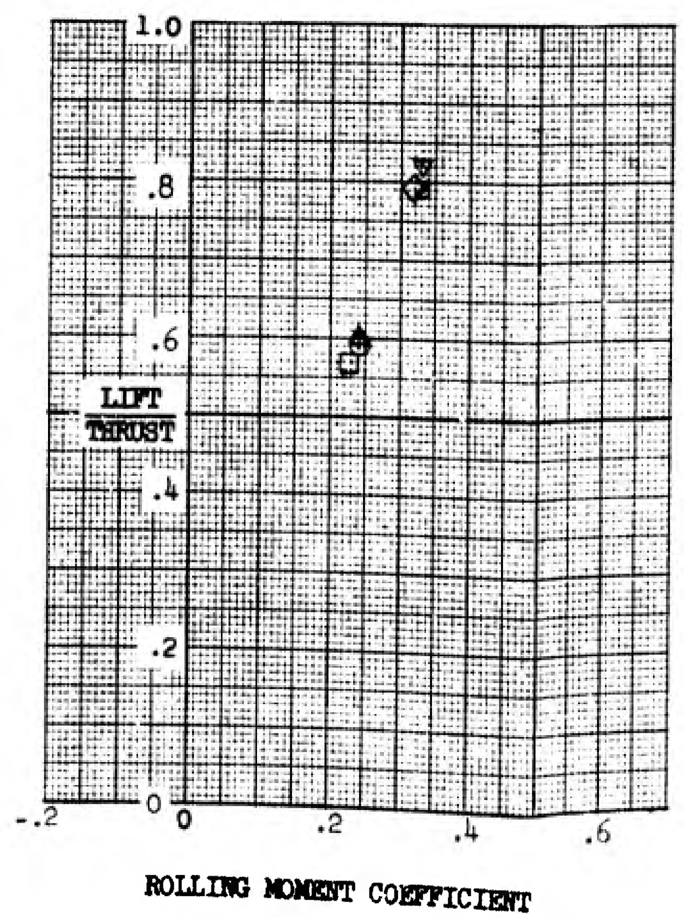
SYM	RUN	GAP/CHORD	STAGGER/CHORD	D	E	D_1	E_1	L
○	B 7.3	1.10	-0.30	37.50	33.00	42.50	40.50	8.50
△	B 7.4	1.10	-0.30	40.00	37.00	40.00	37.00	9.13
□	B 7.5	1.10	-0.30	42.50	40.50	37.50	33.00	10.00
▽	B 22.1	0.695	-1.53	37.50	33.00	42.50	40.50	16.00
◇	B 22.3	0.695	-1.53	40.00	37.00	40.00	37.00	16.50
⊿	B 22.5	0.695	-1.53	42.50	40.50	37.50	33.00	17.50

NOTE: Refer to sketch at the bottom of Figure 19 for location of variables.









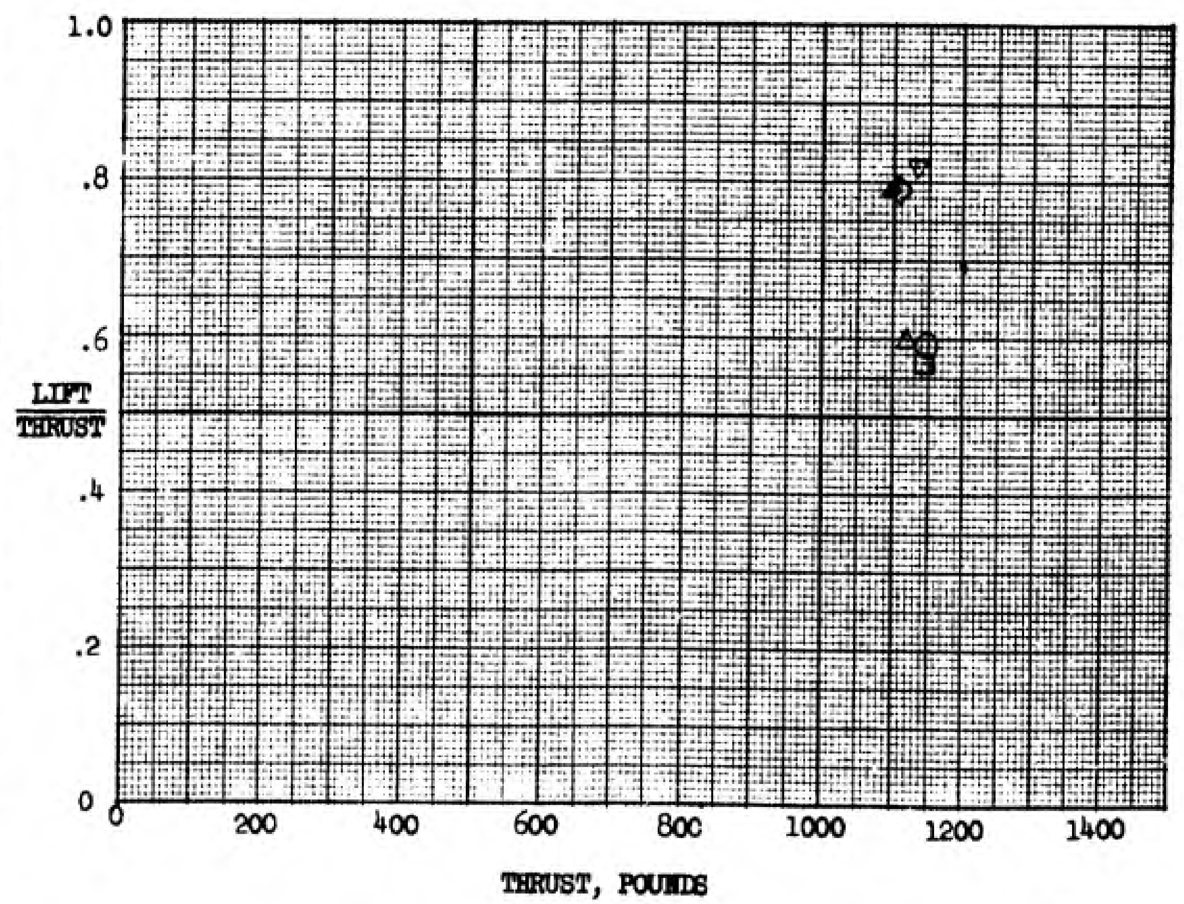


Figure 84

MODEL 88 BIPLANE CONFIGURATION

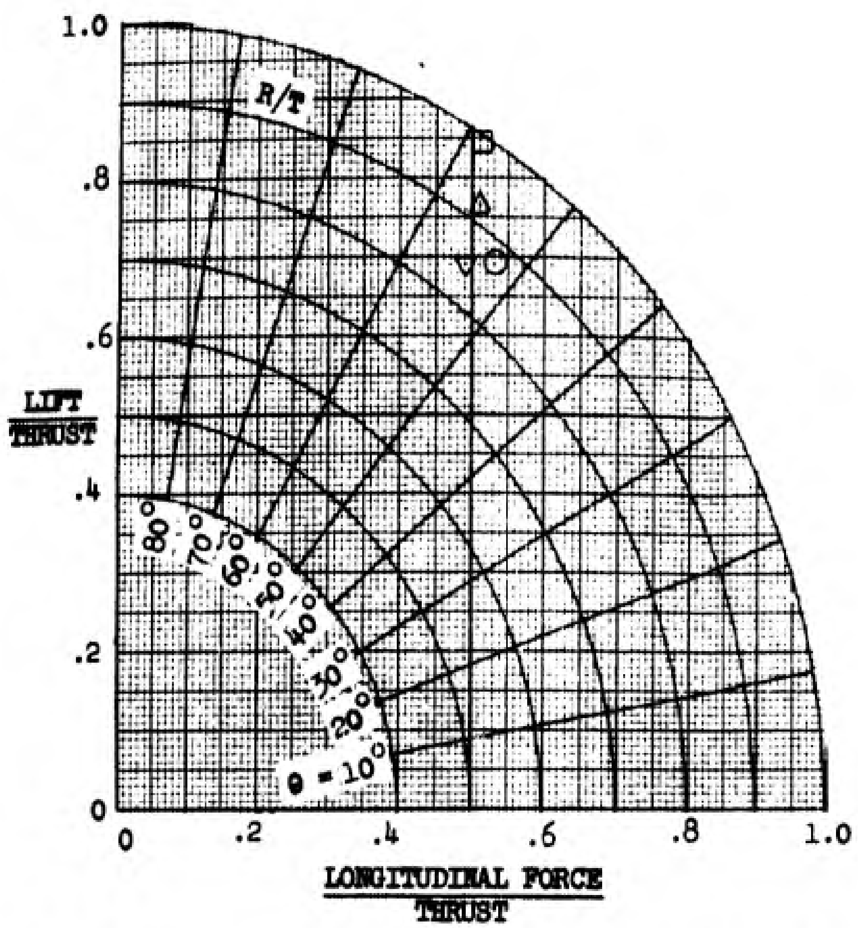
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

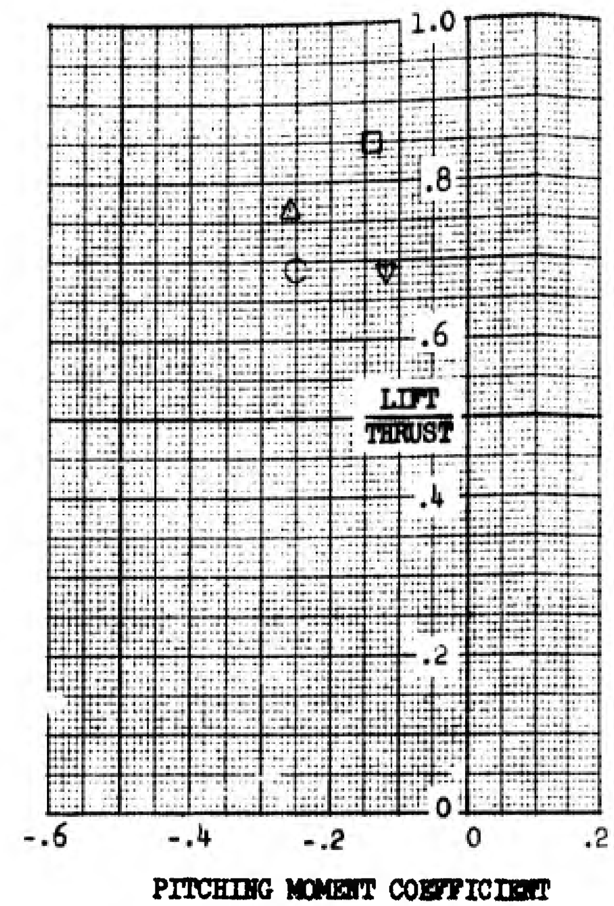
Effect of Auxiliary Vane at Several Vane Angles of Incidence

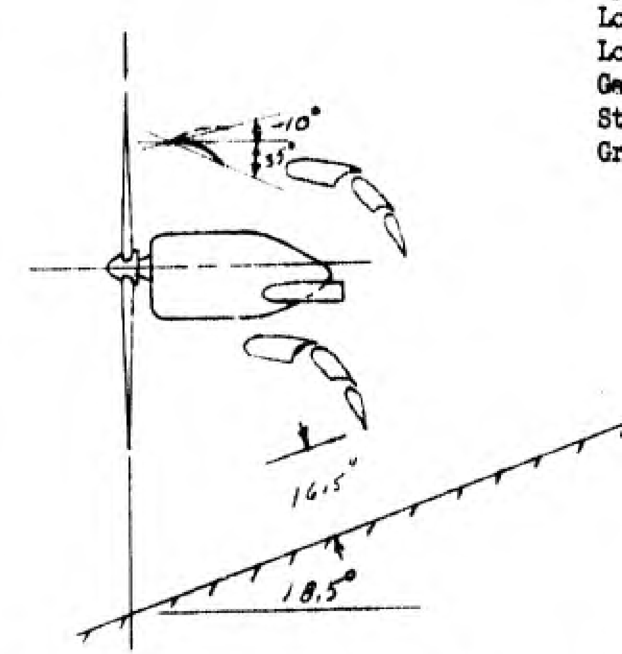
With the Upper Wing at 20° and the Lower Wing at 5° Angle of Incidence

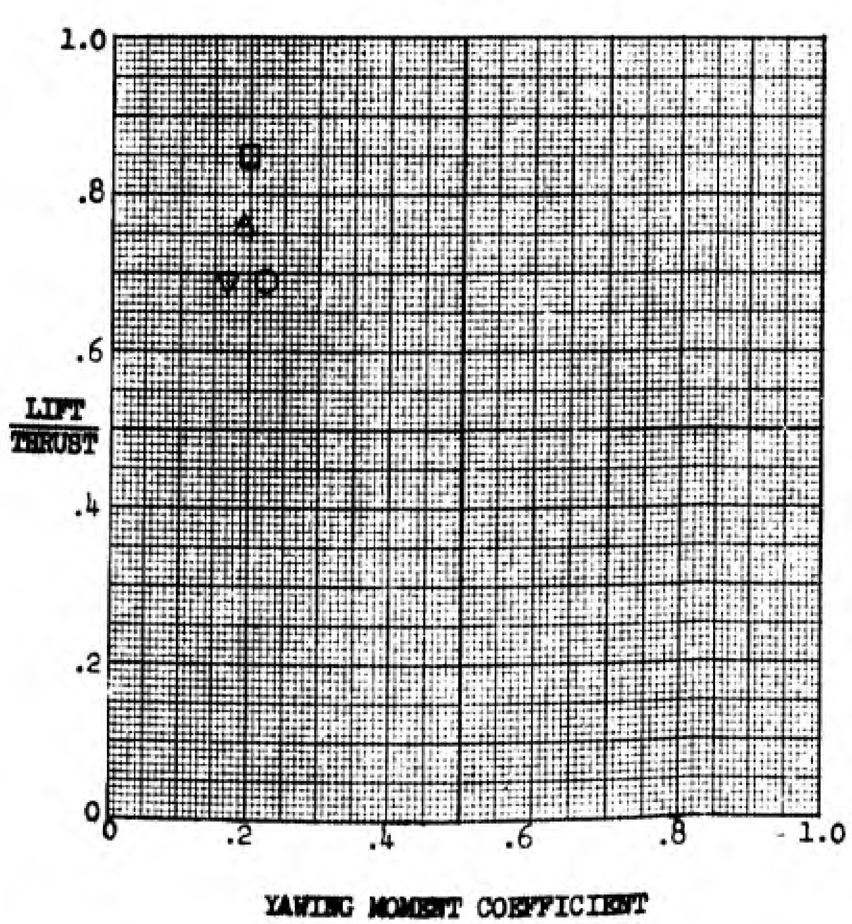
Upper wing forward flap = 40° deflection
Upper wing aft flap = 37° deflection
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

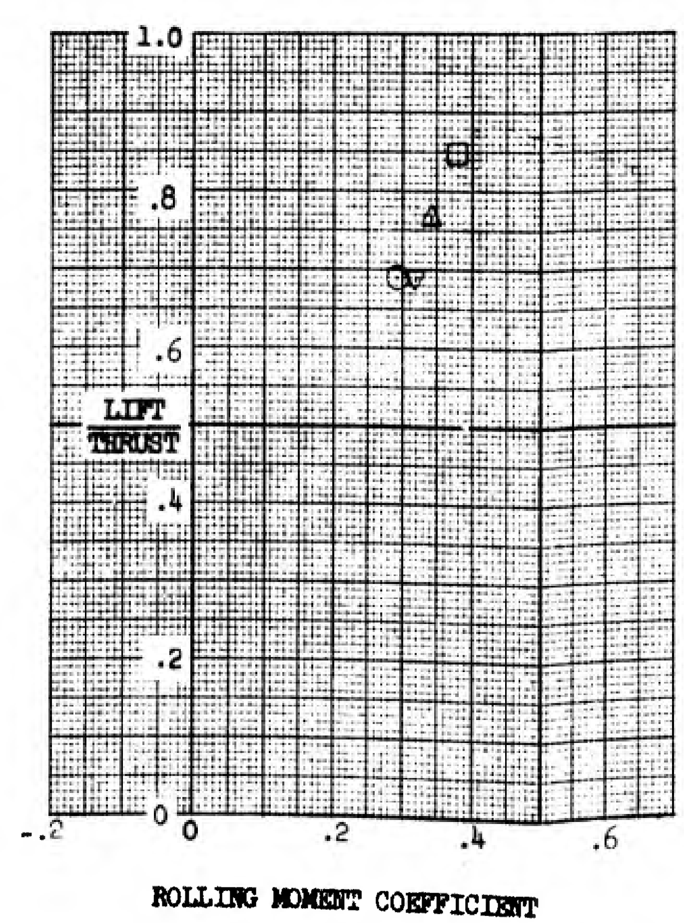
SYM	RUN	AUXILIARY VANE ANGLE
○	B 25.1	-10
△	B 25.2	5
□	B 25.3	20
▽	B 25.4	35











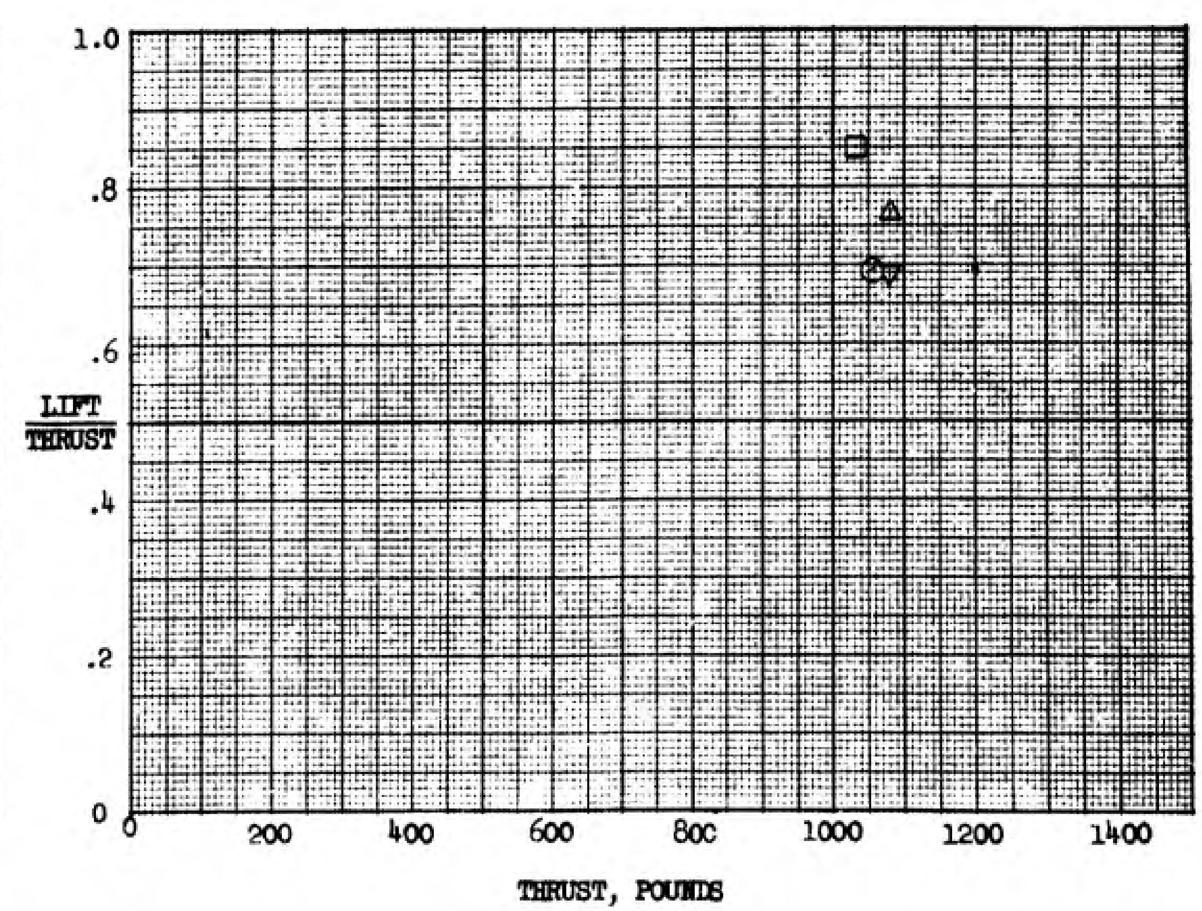


Figure 85

MODEL 88 BIPLANE CONFIGURATION

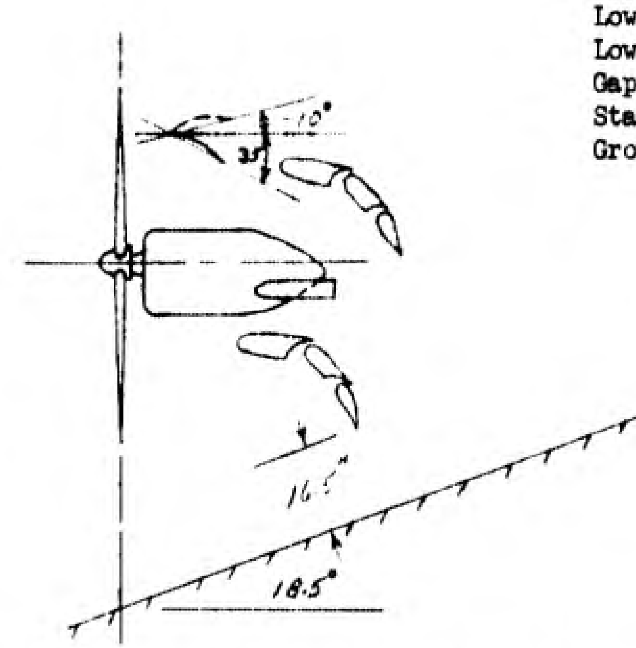
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

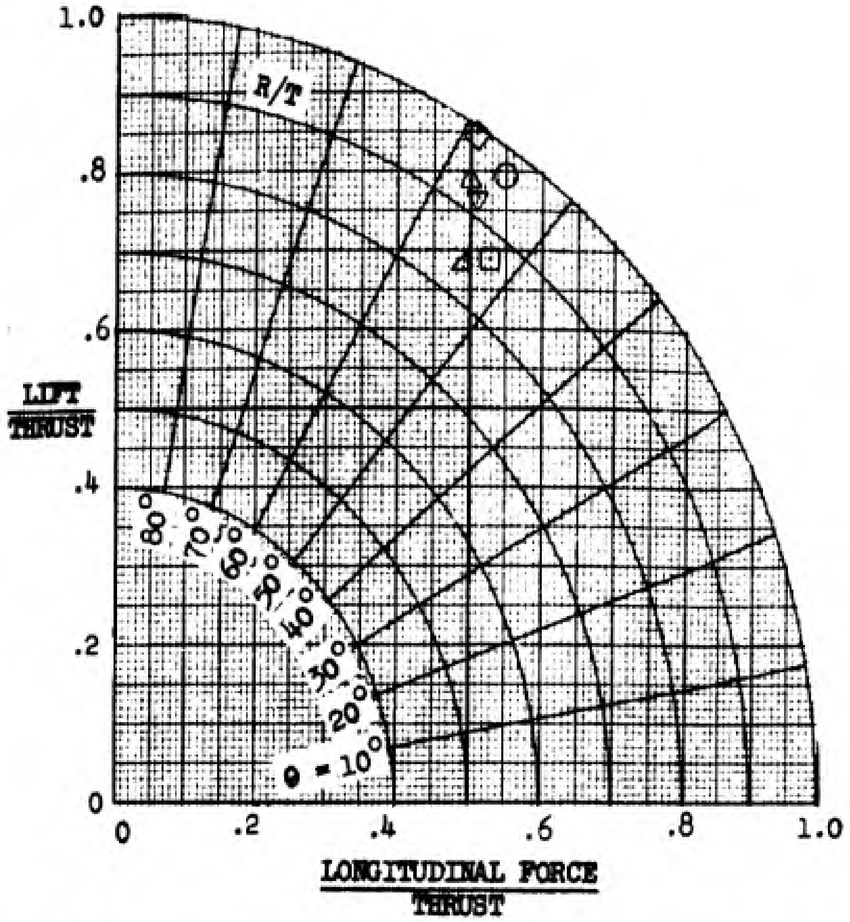
Effect of Auxiliary Vane at Several Vane Angles of Incidence

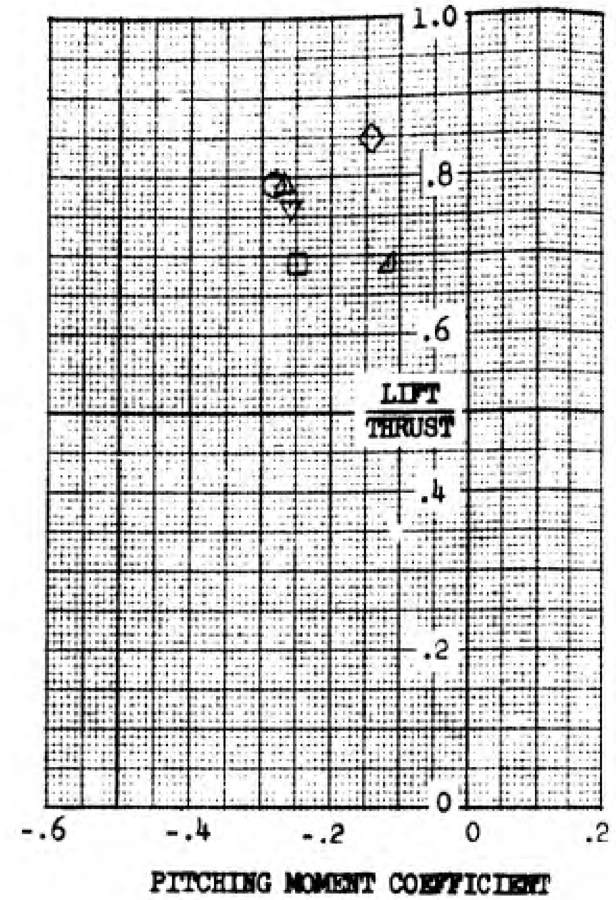
With the Upper Wing at 20° and the Lower Wing at 5° Angle of Incidence

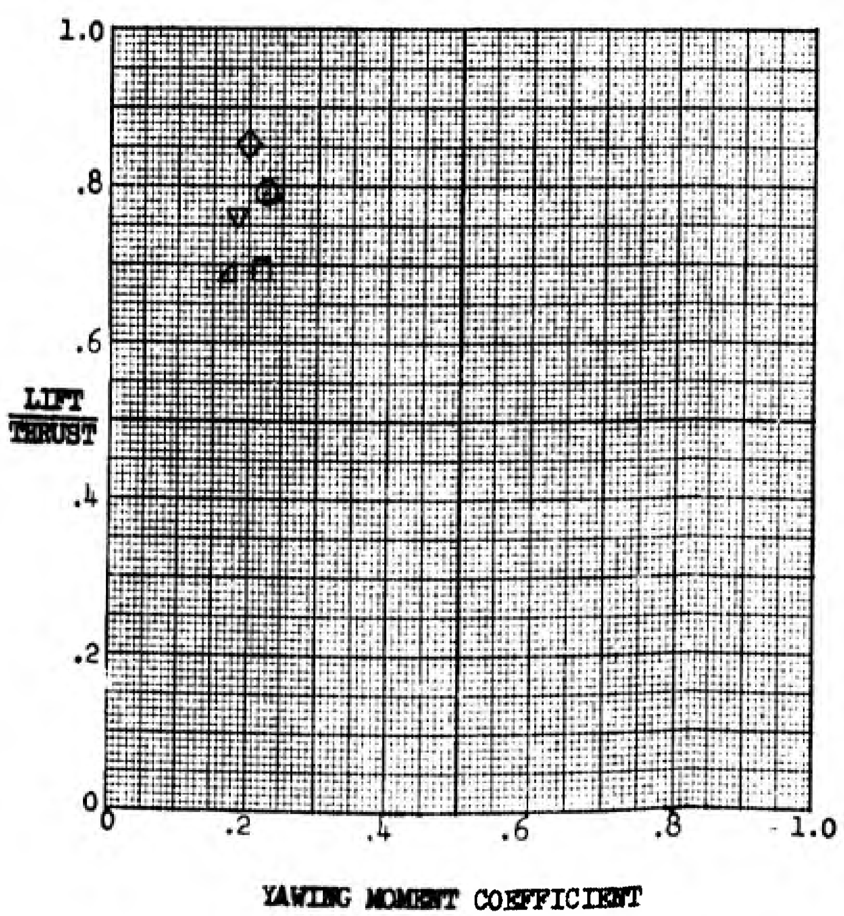
Upper wing forward flap	= 40° deflection
Upper wing aft flap	= 37° deflection
Lower wing forward flap	= 40° deflection
Lower wing aft flap	= 37° deflection
Gap/chord ratio	= 0.695
Stagger/chord ratio	= 1 53
Ground plane installed	

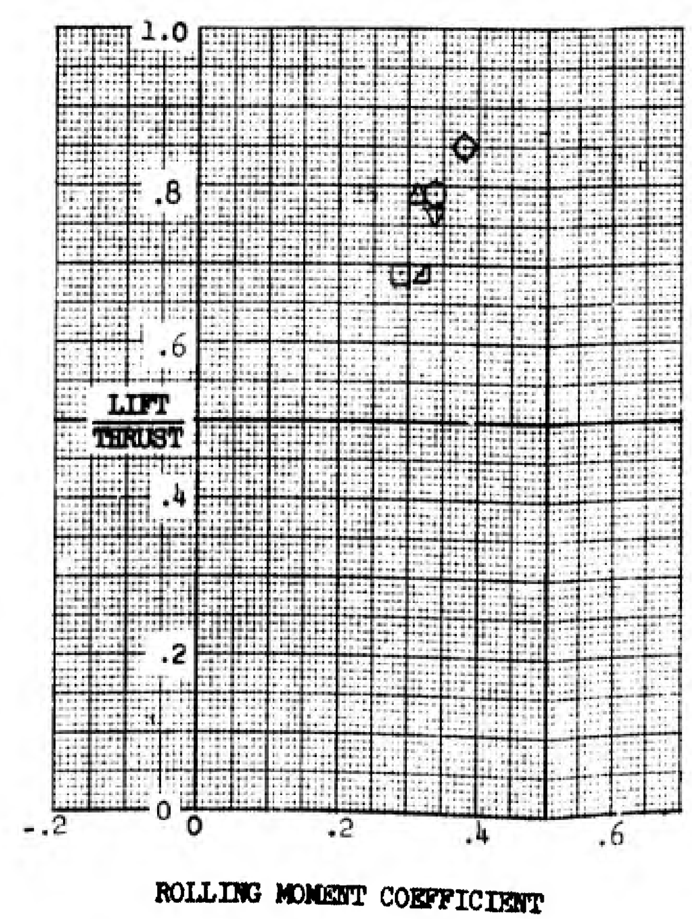
SYM	RUN	AUXILIARY VANE ANGLE
○	B 16.3	No Vane
△	B 22.3	No Vane
□	B 25.1	-10
▽	B 25.2	5
◇	B 25.3	20
◿	B 25.4	35











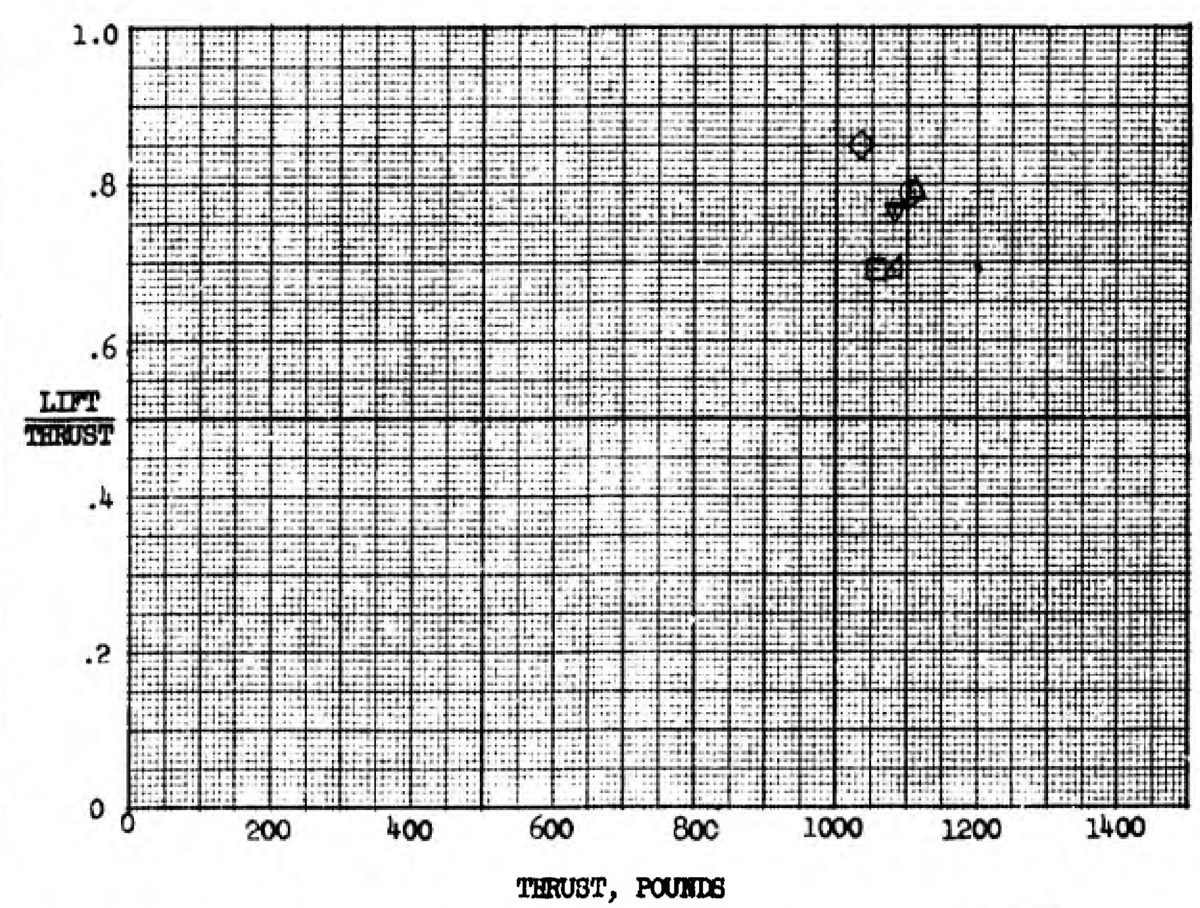


Figure 86

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Pitching Moment Coefficient with Angle of Incidence of Auxiliary Vane Mounted Above and Ahead of the Wing (Sketches 6, 7, 8, 9 and 10 of Figure 17)

SYMBOL	RUN	ANGLE OF INCIDENCE OF VANE	LEAD. EDGE OF VANE ABOVE LEAD. EDGE OF WING	TRAIL. EDGE OF VANE ABOVE LEAD. EDGE OF WING
○	63	12.5°	14.75"	11.5"
△	64	15.5°	8.0 "	4.0"
□	65	6.0°	7.0 "	5.5"
◇	66	0°	6.5 "	6.5"
◁	67	-9.0°	5.5 "	8.0"

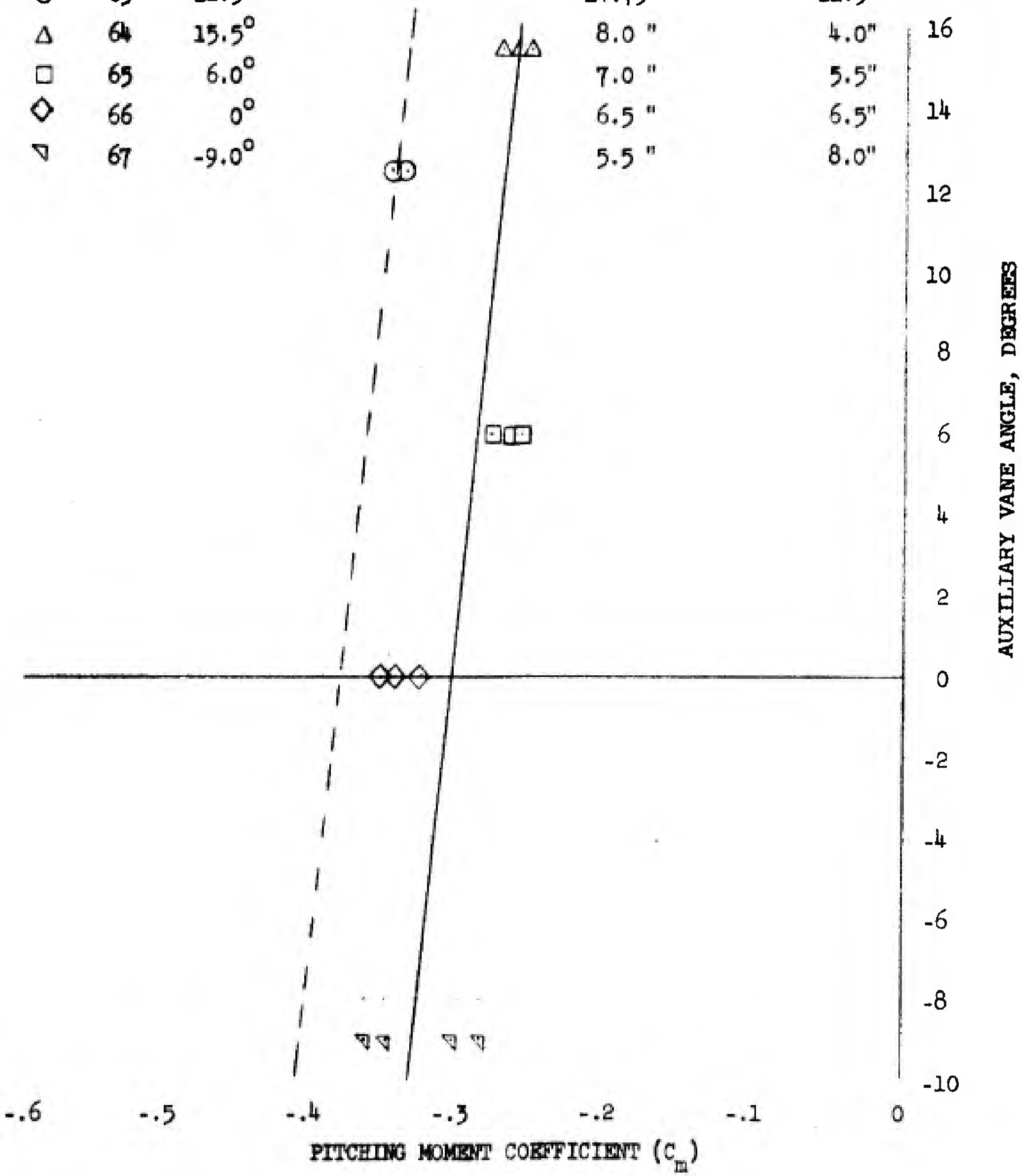


Figure 87

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Yawing Moment Coefficient with Angle of Incidence of Auxiliary Vane Mounted Above and Ahead of the Wing (Sketches 6, 7, 8, 9 and 10 of Figure 17)

SYM	RUN	ANGLE OF INCIDENCE OF VANE	L. E. OF VANE ABOVE L.E. OF WING	T.E. OF VANE ABOVE L.E. OF WING
○	63	12.5°	14.75"	11.5"
△	64	15.5°	8.0 "	4.0"
□	65	6.0°	7.0 "	5.5"
◇	66	0°	6.5 "	6.5"
▽	67	- 9.0°	5.5 "	8.0"

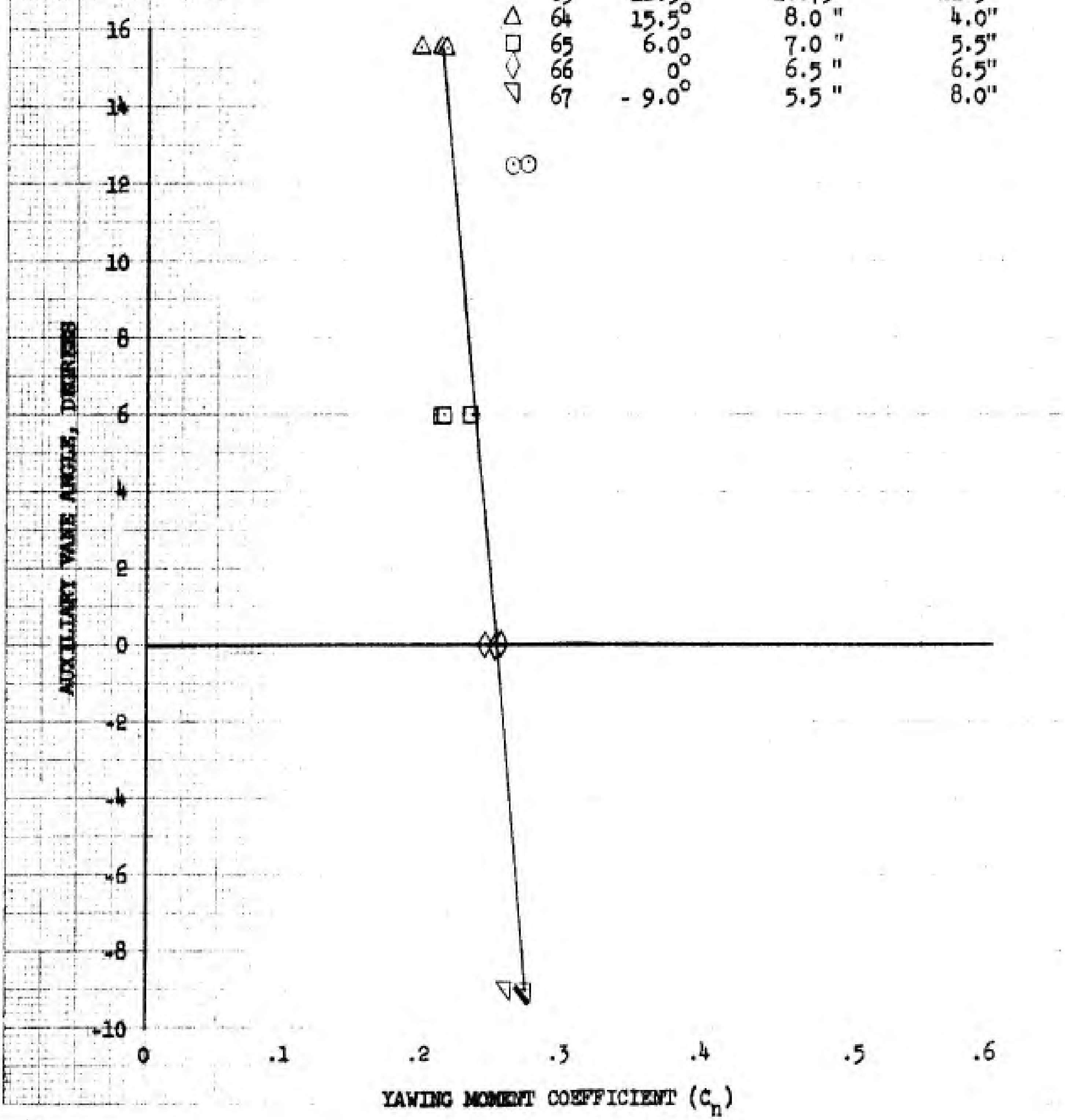


Figure 88

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Rolling Moment Coefficient with Angle of Incidence of Auxiliary Vane Mounted Above and Ahead of the Wing (Sketches 6, 7, 8, 9 and 10 of Figure 17)

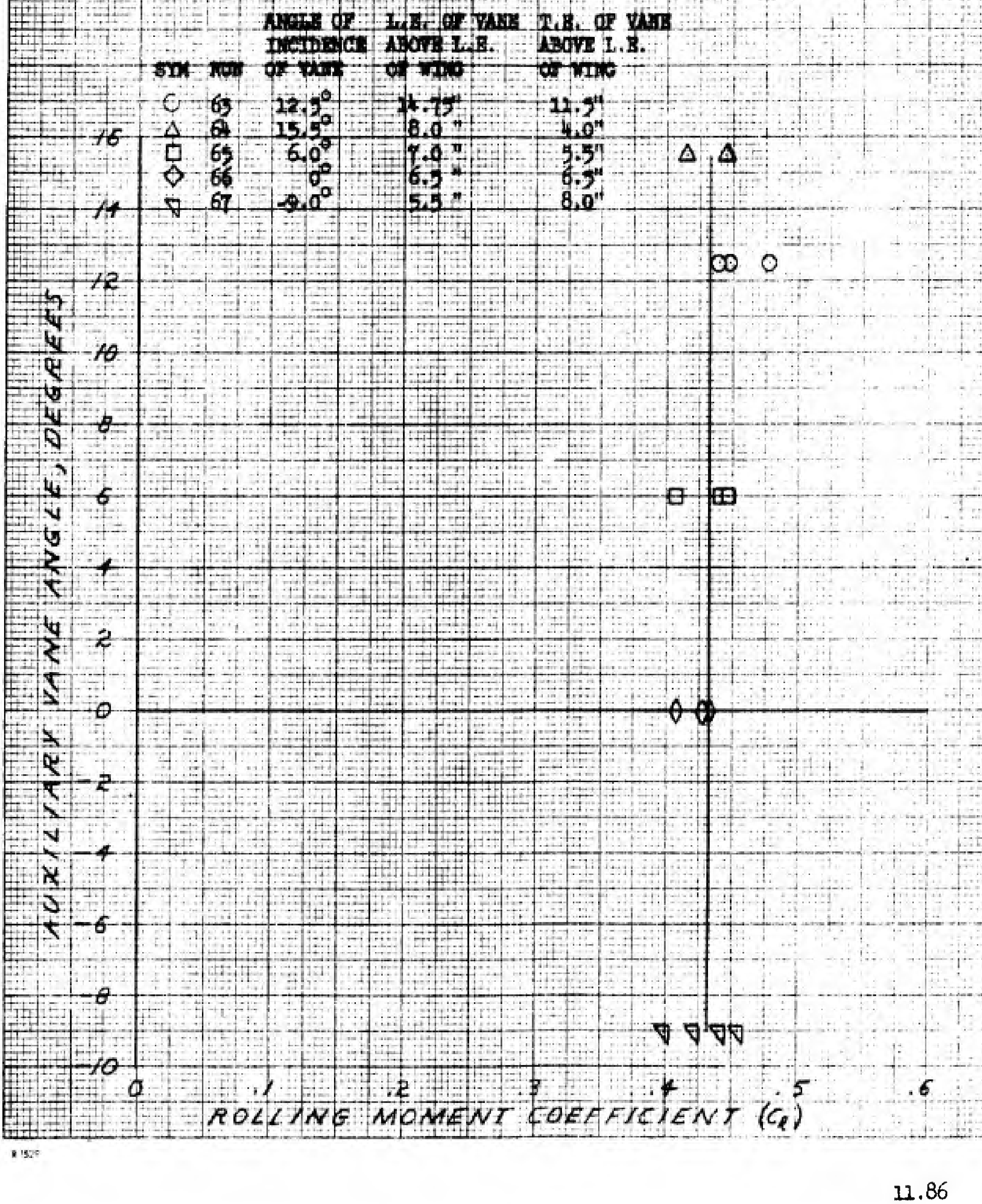


Figure 89

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Pitching Moment Coefficient for Angular Displacement Of Perpendicular Vane with Wing at 13° Angle of Incidence and Forward and Aft Flaps Deflected 30°, Ground Plane Installed

SYMBOL	RUN
○	76.1
△	76.2
□	76.3
▽	76.4
◇	76.5

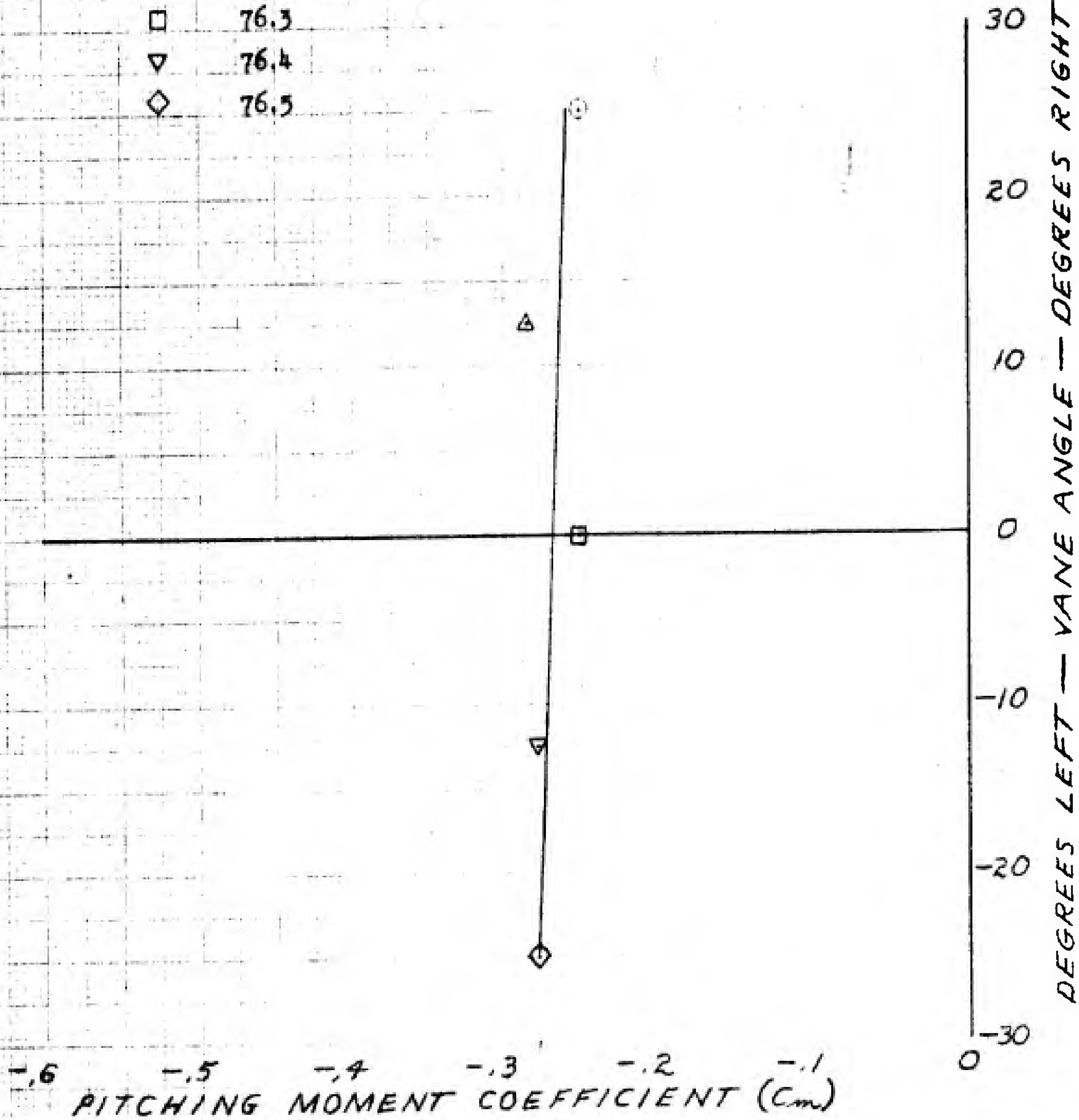


Figure 90

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Yawing Moment Coefficient for Angular Displacement Of Perpendicular Vane with Wing at 13° Angle of Incidence And Forward and Aft Flaps Deflected 30°, Ground Plane Installed

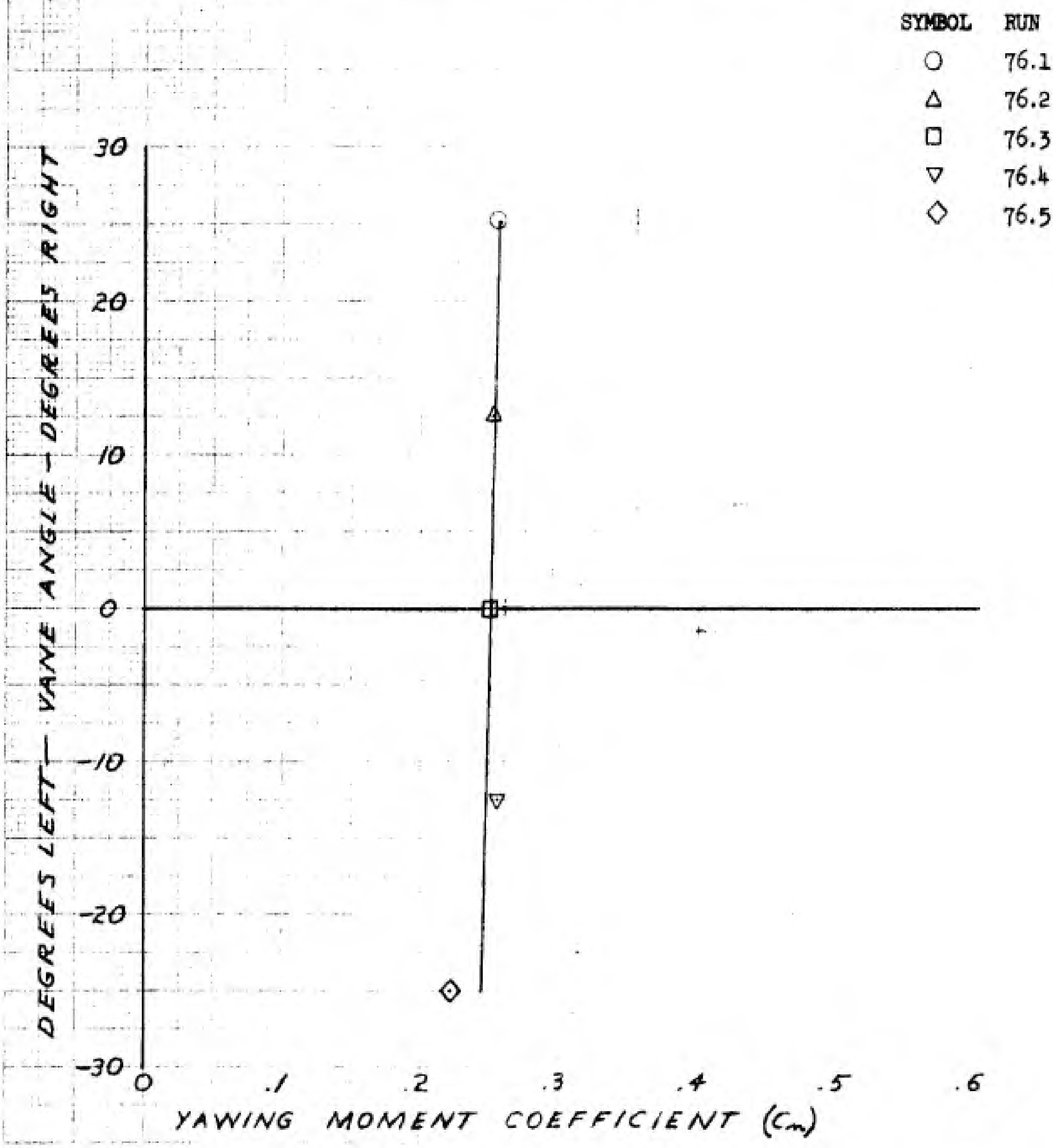


Figure 91

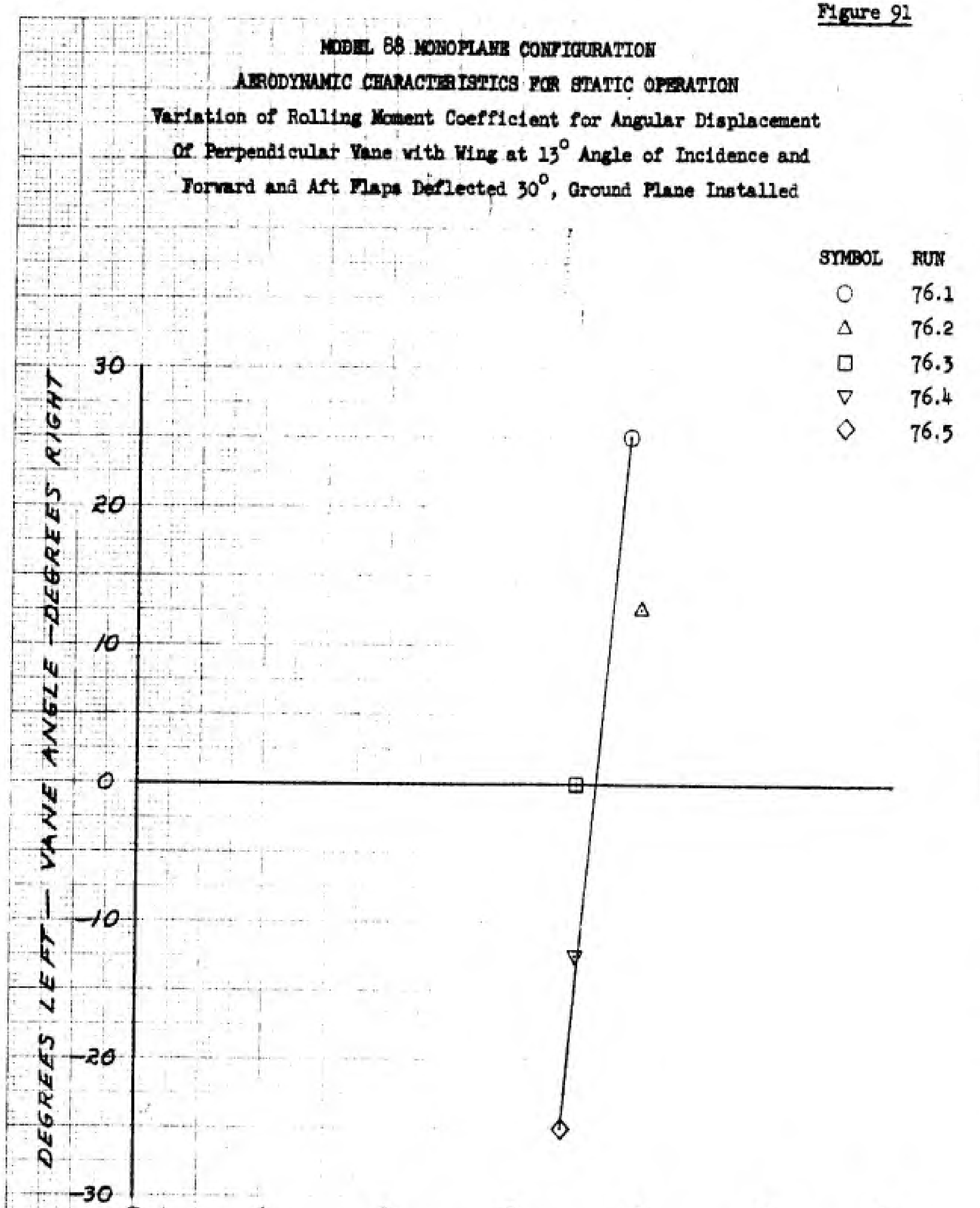

MODEL 88 MONOPLANE CONFIGURATION
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION
Variation of Rolling Moment Coefficient for Angular Displacement
Of Perpendicular Vane with Wing at 13° Angle of Incidence and
Forward and Aft Flaps Deflected 30°, Ground Plane Installed
SYMBOL RUN
○ 76.1
△ 76.2
□ 76.3
▽ 76.4
◇ 76.5
DEGREES LEFT — VANE ANGLE — DEGREES RIGHT
30
20
10
0
-10
-20
-30
0
.1
.2
.3
.4
.5
.6
ROLLING MOMENT COEFFICIENT (C_l)

Figure 92

MODEL 88 MONOPLANE CONFIGURATION
AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION
Variation of Pitching Moment Coefficient with Control Tab Deflection
(Sketches 11, 12, 13 and 14 of Figure 17)

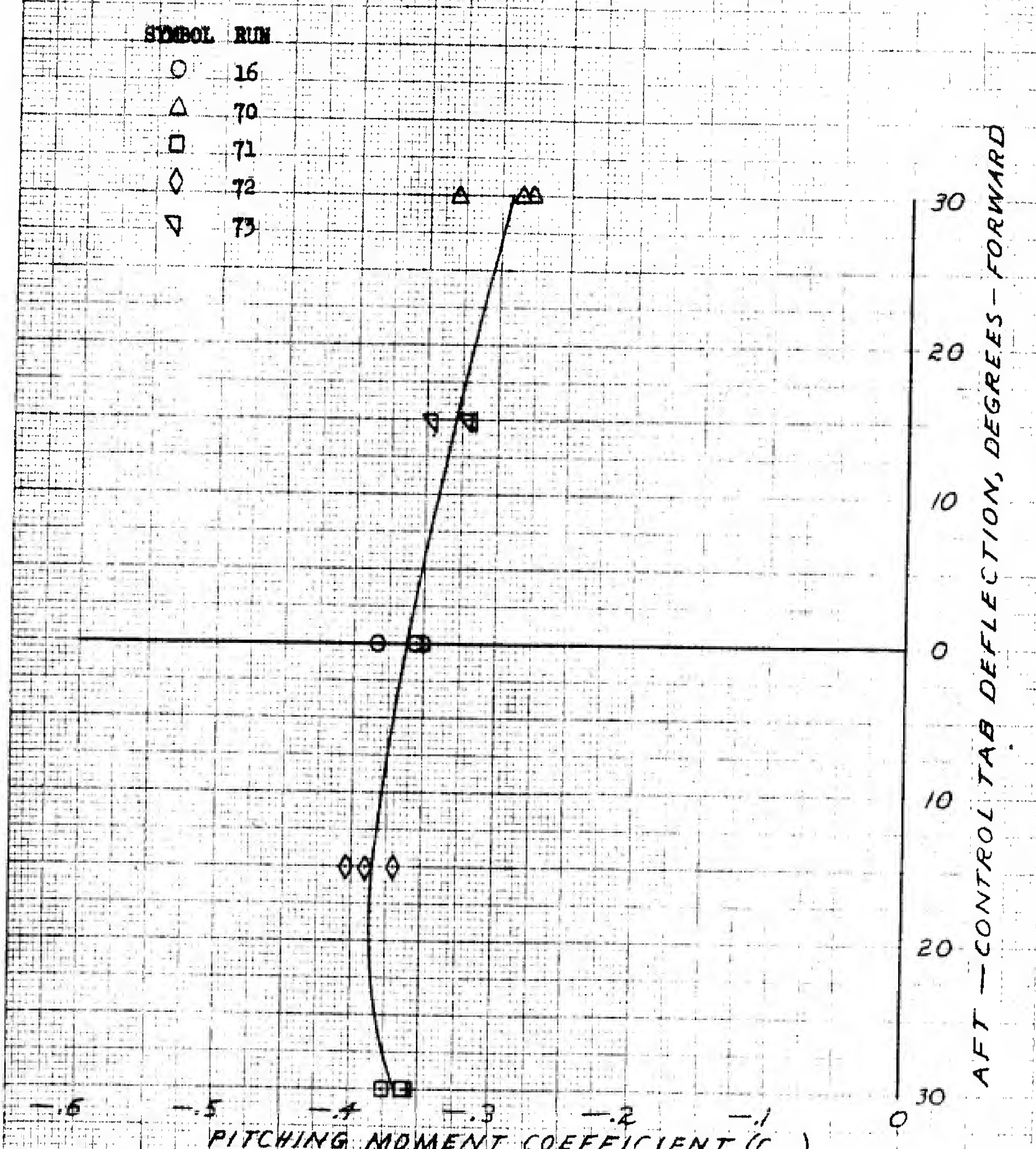


Figure 93

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Yawing Moment Coefficient With Control Tab Deflection

(Sketches 11, 12, 13 and 14 of Figure 17)

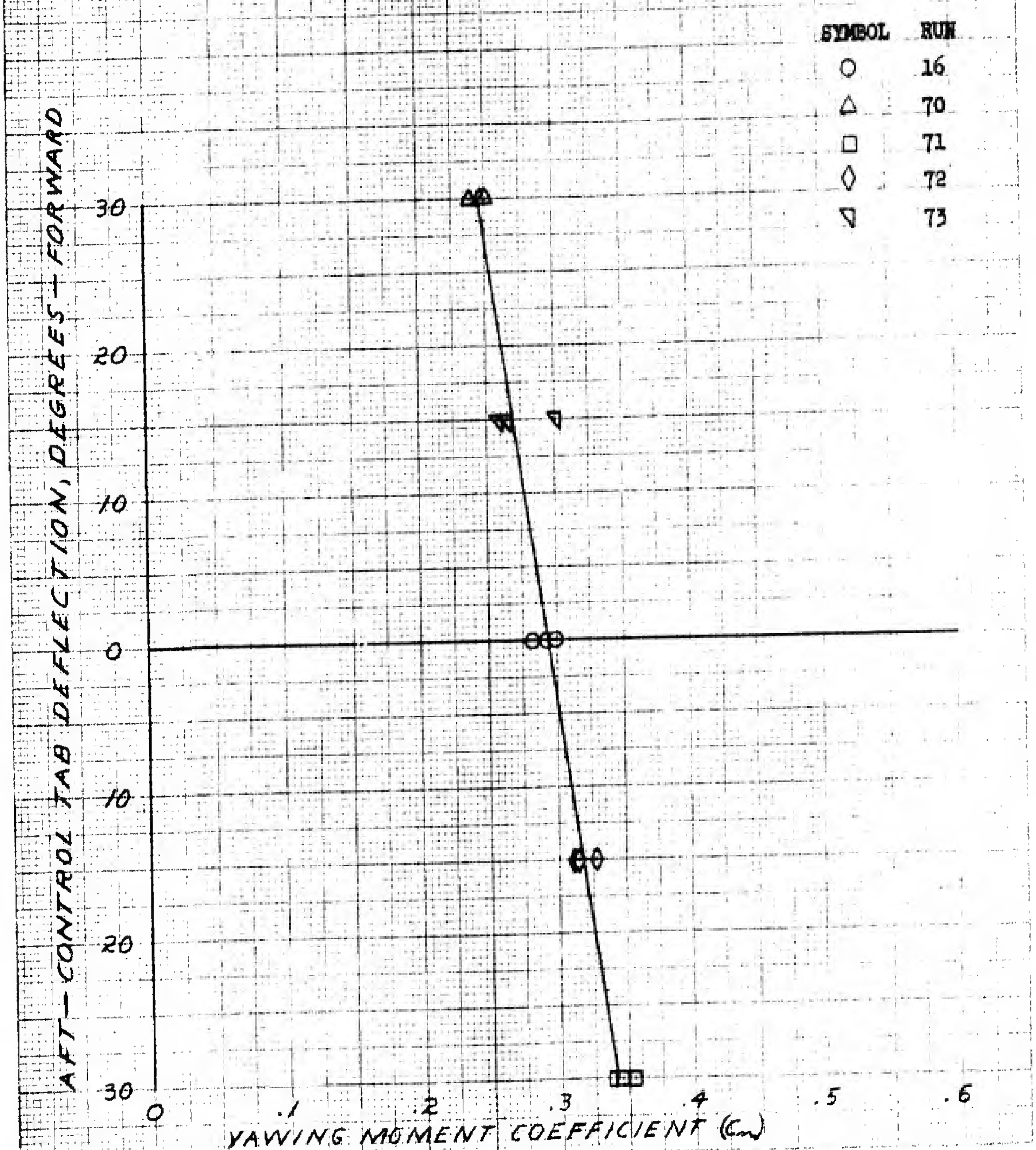


Figure 94

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Rolling Moment Coefficient with Control Tab Deflection

(Sketches 11, 12, 13 and 14 of Figure 17)

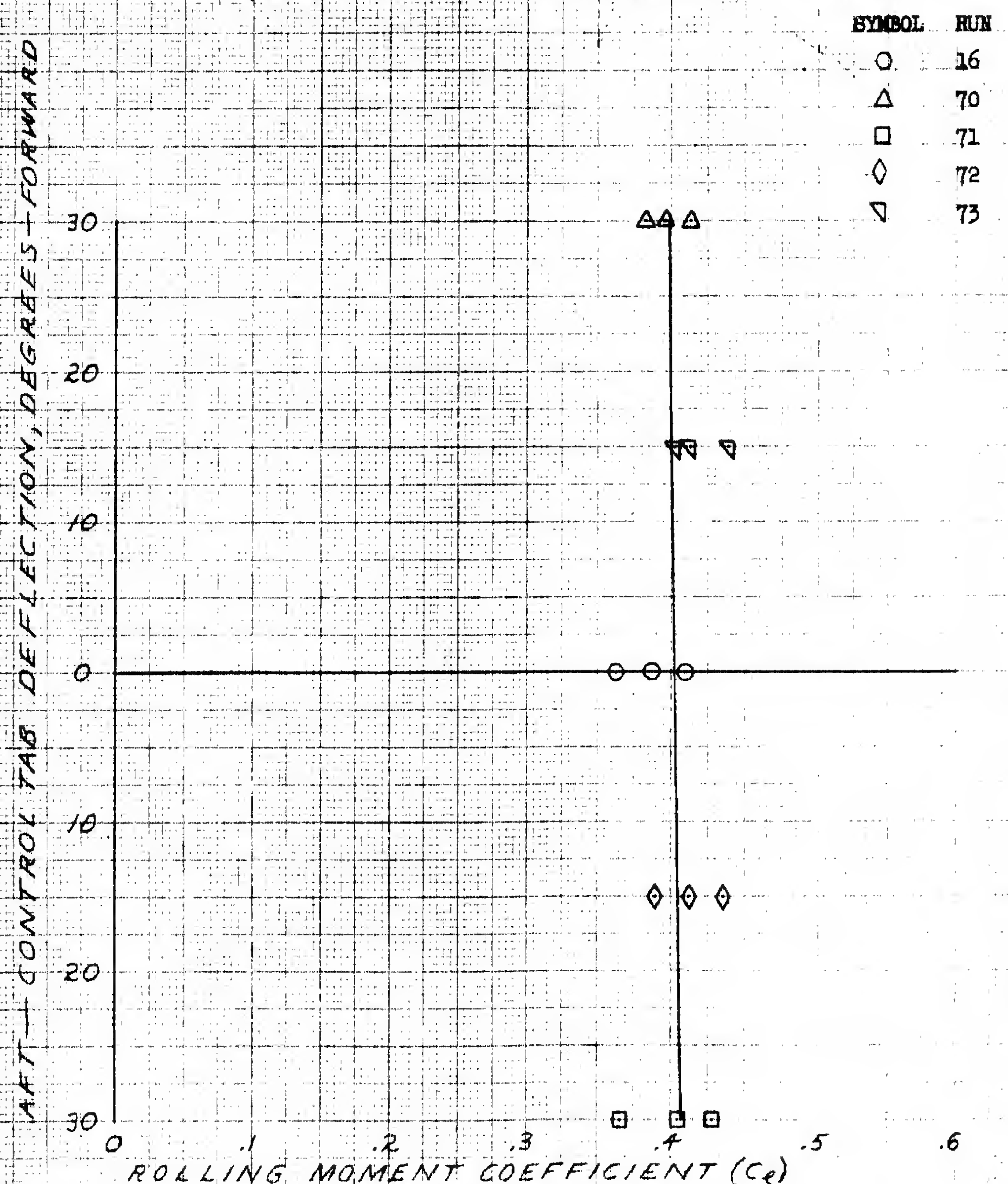


Figure 95

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Pitching Moment Coefficient for Angular Displacement Of Spoiler and Change in Wing-Flap Gap Distance with Wing at 13° Angle of Incidence and Forward and Aft Flaps Deflected 30°, Ground Plane Installed

SYM	RUN	SPOILER ANGLE	D
○	74.1	- 6.5	00.06
△	74.2	0	00.90
□	74.3	20.0	3.75
◇	74.4	40.0	6.38
◹	74.5	60.0	8.63
◁	74.6	80.0	10.38
◊	74.7	94.5	11.50

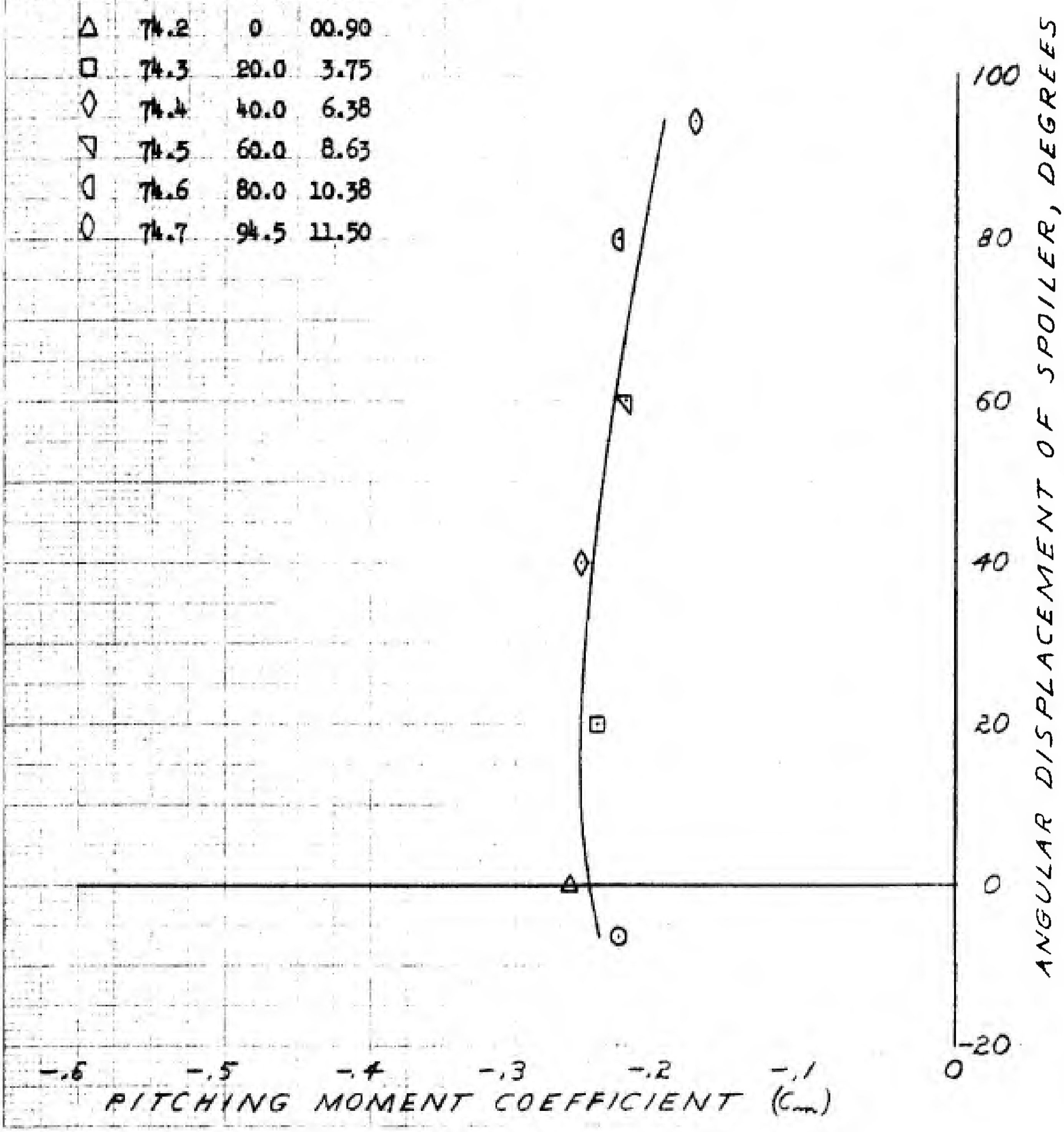


Figure 96

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Yawing Moment Coefficient for Angular Displacement Of Spoiler and Change in Wing-Flap Gap Distance with Wing at 13° Angle of Incidence and Forward and Aft Flaps Deflected 30°, Ground Plane Installed

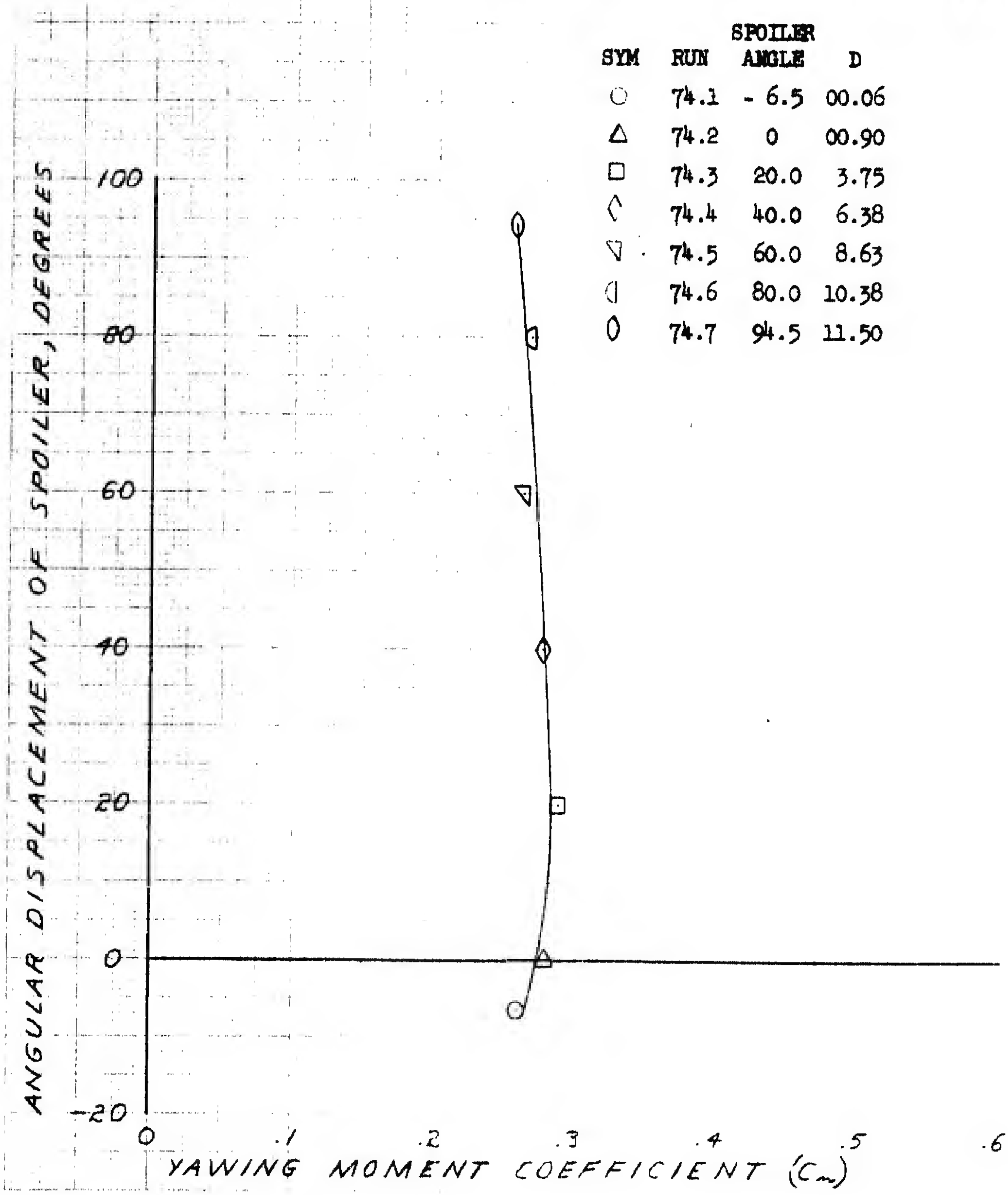
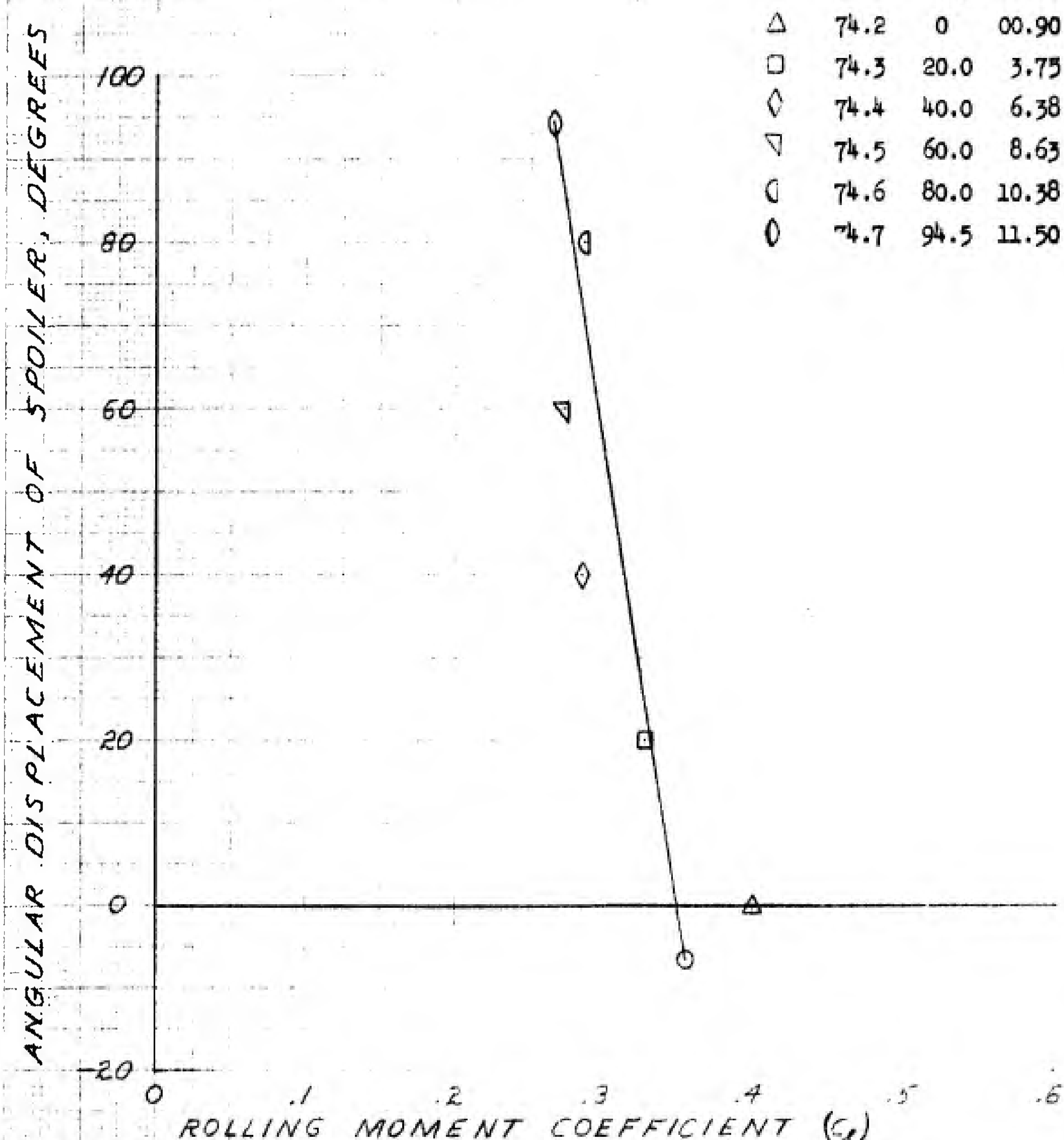


Figure 97

MODEL 88 MONOPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation of Rolling Moment Coefficient for Angular Displacement Of Spoiler and Change in Wing-Flap Gap Distance with Wing at 13° Angle of Incidence and Forward and Aft Flaps Deflected 30°, Ground Plane Installed



SYM	RUN	SPOILER ANGLE	D
○	74.1	- 6.5	00.06
△	74.2	0	00.90
□	74.3	20.0	3.75
◇	74.4	40.0	6.38
▽	74.5	60.0	8.63
○	74.6	80.0	10.38
◇	74.7	94.5	11.50

Figure 98

MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation in Pitching Moment Coefficient with Angle of Incidence of the Auxiliary Vane with Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

Upper wing forward flap = 40° deflection
Upper wing aft flap = 37° deflection
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

SYMBOL	RUN
○	25.1
△	25.2
□	25.3
▽	25.4

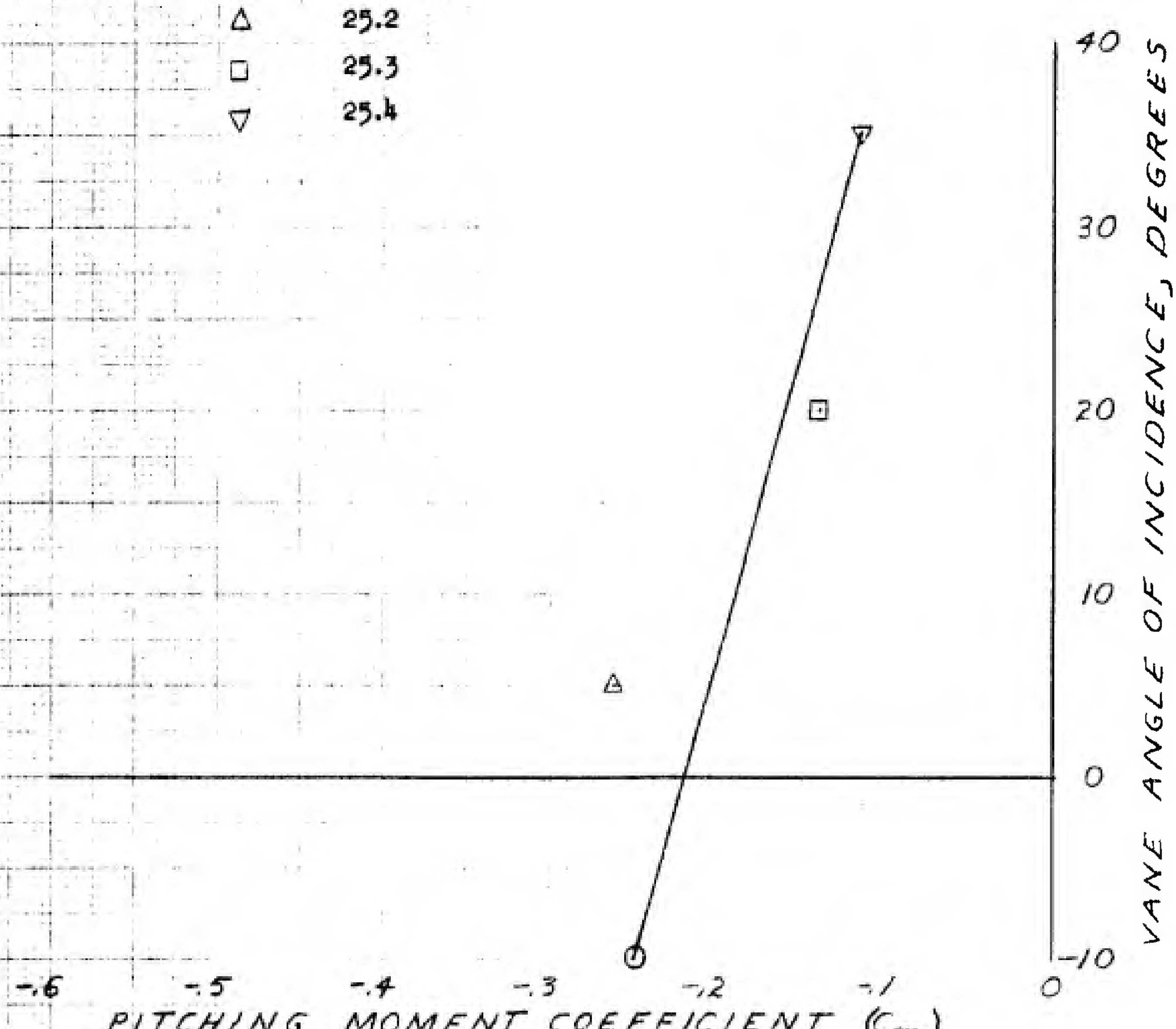


Figure 99

MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation in Yawing Moment Coefficient with Angle of Incidence of the Auxiliary Vane With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence

Upper wing forward flap = 40° deflection
Upper wing aft flap = 37° deflection
Lower wing forward flap = 40° deflection
Lower wing aft flap = 37° deflection
Gap/chord ratio = 0.695
Stagger/chord ratio = -1.53
Ground plane installed

SYMBOL	RUN
○	25.1
△	25.2
□	25.3
◇	25.4

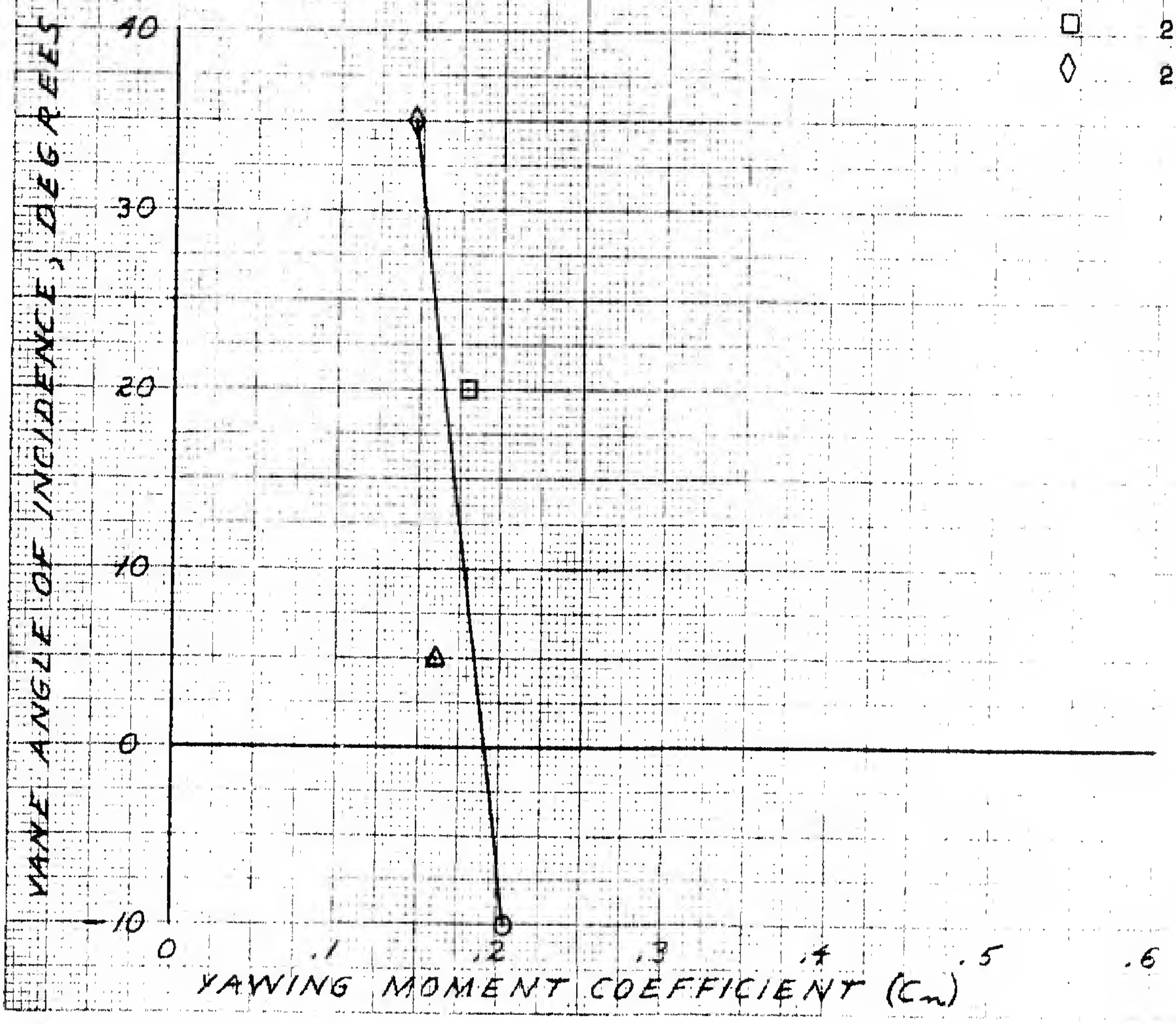
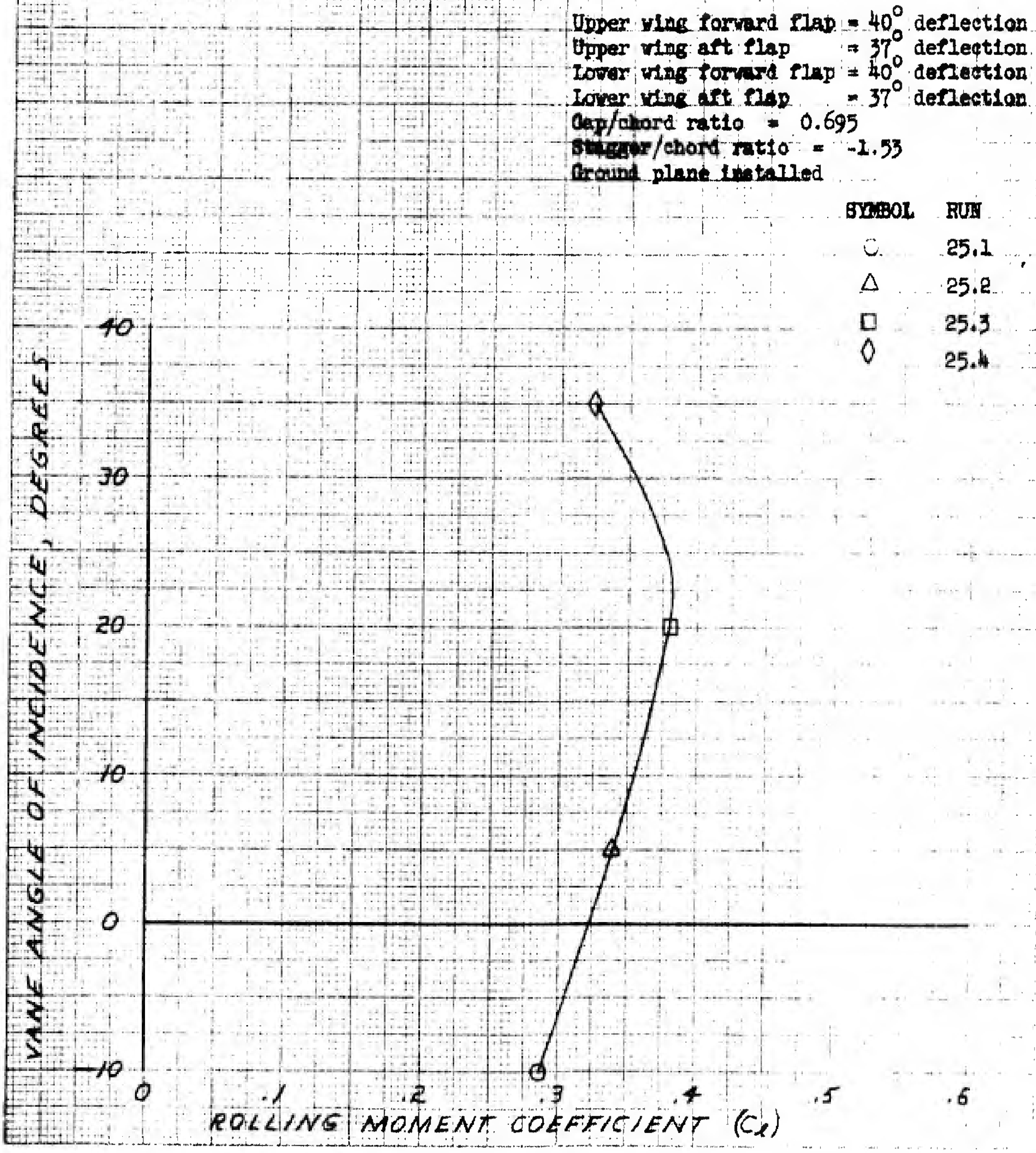


Figure 100

MODEL 88 BIPLANE CONFIGURATION

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

Variation in Rolling Moment Coefficient with Angle of Incidence of the Auxiliary Vane With Upper Wing at 20° and Lower Wing at 5° Angle of Incidence



RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM RANGE LOWEST	RPM RANGE HIGHEST	WING SETTINGS A	WING SETTINGS B	WING SETTINGS C	FLAP SETTINGS FORWARD D	FLAP SETTINGS FORWARD E	FLAP SETTINGS FORWARD F	FLAP SETTINGS AFT G	FLAP SETTINGS AFT H	FLAP SETTINGS AFT I	GROUND PLANE J	GROUND PLANE K	PROPELLER DATA DIAMETER	PROPELLER DATA NO. OF BLADES	PROPELLER DATA BLADE ANGLE	PROPELLER DATA BLADE STATION	REMARKS
8-25-55	1	2490	3330	25.34	28.62	8.75	0	0	0	0	0	0	101.5	0	102	3	6.5	38.06	Fence in front of propeller removed for subsequent runs
8-26-55	2	2500	2900	25.34	28.62	8.75	0	0	0	0	0	0	101.5	0	102	3	6.5	38.06	
8-26-55	3	2530	3310										101.5	0	102	3	6.5	38.06	
8-29-55	4	2520	3320										101.5	0	102	3	6.0	38.06	
8-30-55	5	2490	3070										101.5	0	102	3	8.0	38.06	
8-31-55	6	2515	3405										101.5	0	90.75	2	12.85 13.75	34.03	Severe vibrations
9- 1-55	6.1	2520	3440										101.5	0	90.75	2	13.75	34.03	
9- 1-55	7	2470	3410										101.5	0	90.75	2	7.9	34.03	
9- 6-55	8	2840	3020	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	49	101.5	0	101.5	3	8.9	38.06	Severe vibrations
9- 7-55	8.1	2540	3040	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	49	101.5	0	101.5	3	8.9	38.06	
9- 8-55	9	2780	2980	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	40	101.5	0	101.5	3	8.9	38.06	
9- 9-55	10	2750	2970	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	30	101.5	0	101.5	3	8.9	38.06	Oil cooler fan removed and shield added over oil cooler, battery and 4' beam
9- 9-55	10.1	2780	3020	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	30	101.5	0	101.5	3	8.9	38.06	Shield removed and fan replaced
9-14-55	11	2800	2995	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
9-14-55	12	2820	3010	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	40	79.5	18.5	101.5	3	8.9	38.06	
9-14-55	13	2810	3080	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	49	79.5	18.5	101.5	3	8.9	38.06	
9-14-55	14	2800	3000	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	49	79.5	18.5	101.5	3	8.9	38.06	Side plate on right side only
9-15-55	15	2240	2955	25.34	28.62	8.75	0.9	4.56	45	0.9	0.4	49	79.5	18.5	101.5	3	8.9	38.06	Side plate on left side only
9-16-55	16	2800	3010	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
9-16-55	17	2765	2945	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	40	79.5	18.5	101.5	3	8.9	38.06	
9-16-55	18	2780	3005	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	49	79.5	18.5	101.5	3	8.9	38.06	
9-19-55	19	2800	3015	25.34	28.62	8.75	2.25	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
9-20-55	20	2840	3030	25.34	28.62	8.75	2.25	3.62	30	0.9	0.4	40	79.5	18.5	101.5	3	8.9	38.06	
9-23-55	21	2840	2985	25.34	28.62	8.75	0.25	4.75	30	0.25	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
9-23-55	22	2845	2975	25.34	28.62	8.75	0.25	4.75	30	0.25	0.4	40	79.5	18.5	101.5	3	8.9	38.06	
9-28-55	23	2810	2995	25.34	28.62	8.75	0.9	2.0	20	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM RANGE		WING SETTINGS			FLAP SETTINGS						GROUND PLANE		PROPELLER DATA				REMARKS
							FORWARD			AFT									
		LOWEST	HIGHEST	A	B	C	D	E	F	G	H	I	J	K	DIAMETER	NO. OF BLADES	BLADE ANGLE	BLADE STATION	
9-29-55	24	2795	3005	25.34	28.62	8.75	0.9	2.0	20	0.9	0.4	40	79.5	18.5	101.5	3	8.9	38.06	
9-30-55	25	2780	3020	25.34	28.62	8.75	0.9	3.88	35	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
10- 3-55	26	2775	3110	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
10- 4-55	27	2833	3135	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
10-5 -55	28	2925	3120	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	End plate added on left side
10 -5-55	29	3015	3335	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	6.9	38.06	End plate added on left side
10- 6-55	30	2930	3080	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	End plate on right side and large end plate on left side
10- 7-55	31	2820	2990	26.00	29.25	13.00	0.9	3.62	30	0.9	7.5	30	79.5	18.5	101.5	3	8.9	38.06	End plate on right side and large end plate on left side
10-11-55	32	2810	2990	18.50	26.12	13.00	0.9	3.62	30	0.9	7.5	30	79.5	18.5	101.5	3	8.9	38.06	
10-18-55	33	2775	3000	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 1. Auxiliary flap deflected 10° forward.
10-19-55	34	2835	3015	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary flap deflected 40° forward.
10-19-55	35	2815	2955	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary flap deflected 20° aft
10-20-55	36	2810	3100	25.34	28.62	8.75	0.9	3.88	35	0.9	0.4	35	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 2. Auxiliary flap undeflected.
10-27-55	37	2510	3100										101.5	0	90.75	2	15.5	30.00	
10-27-55	38	2530	3380										101.5	0	90.75	2	13.3	30.38	
10-28-55	39	2620	3415										101.5	0	90.75	2	7.9	34.03	Repeat of Run 7
10-28-55	40	3180	3440	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	101.5	0	90.75	2	7.9	34.03	Housing over oil cooler and battery
10-31-55	41	2800	3105	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	30	101.5	0	101.5	3	8.9	38.06	
11- 2-55	42	2500	3400										101.5	0	90.75	2	5.5	34.03	
11- 4-55	43	2810	2990	8.00	58.20	8.75	0.9	3.62	30	0.9	0.4	30	101.5	0	101.5	3	8.9	38.06	
11- 7-55	44	2810	2990	8.00	58.20	8.75	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Battery removed. Housing over counterweight
11- 7-55	45	2805	2935	8.00	58.20	8.75	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 3. L_v = 42"
11- 8-55	46	2815	2995	18.50	26.12	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 3. L_v = 42"
11- 9-55	47	2805	2975	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 3. L_v = 42"
11-10-55	48	2810	3100	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 3. L_v = 52.2"
11-11-55	49	2820	3000	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 3. L_v = 36"

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM RANGE		WING SETTINGS			FLAP SETTINGS						GROUND PLANE		PROPELLER DATA				REMARKS
							FORWARD			AFT									
		LOWEST	HIGHEST	A	B	C	D	E	F	G	H	I	J	K	DIAMETER	NO. OF BLADES	BLADE ANGLE	BLADE STATION	
11-11-55	50	2780	3015	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 3. $L_v = 35.8$, $H_v = 20$, $b_v = 4$
11-11-55	51	2760	2990	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane off.
11-15-55	52	2805	3005	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 4. $\delta_f = 12°$
11-15-55	53	2830	3000	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	Auxiliary vane per Sketch 4. $\delta_f = 42°$
11-16-55	54	2800	3012	26.00	29.25	13.00	0.9	3.88	35	0.9	0.4	35	101.5	0	101.5	3	8.9	38.06	**Auxiliary vane per Sketch 4. $\delta_f = -5°$**
11-16-55	55	2500	3030										101.5	0	101.5	3	8.9	38.06	Propeller calibrated
11-17-55	56	2395	2855										101.5	0	101.5	3	{10.6 10.6 10.1	38.06	Propeller calibrated
11-18-55	57	2500	3405										101.5	0	90.75	2	10.0	34.03	Propeller calibrated
11-22-55	58	3000	3280	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	20	79.5	18.5	90.75	2	10.0	34.0	
11-22-55	59	2790	2980	25.34	28.62	8.75	0.9	3.62	30	0.9	0.4	20	79.5	18.5	101.5	3	8.9	38.06	
11-29-55	60	2780	2990	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 5.
11-29-55	61	2805	3110	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	20	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 5.
11-29-55	62	2800	3000	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	35	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 5
12- 5-55	63	2805	3000	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 6
12- 6-55	64	2810	3010	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 7
12- 6-55	65	2820	3030	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 8
12- 7-55	66	2830	3000	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 9
12- 7-55	67	2775	3010	26.00	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Auxiliary vane per Sketch 10
12- 9-55	68	2805	3000	36.75	29.25	13.00	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	
12- 9-55	69	2820	3030	36.75	29.25	13.00	0.9	3.88	35	0.9	0.4	35	79.5	18.5	101.5	3	8.9	38.06	
12-14-55	70	280[illegible]	3000	25.34	28.62	8.5	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Control tab per Sketch 11
12-15-55	71	2830	3010	25.34	28.62	8.5	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Control tab per Sketch 12
12-15-55	72	2805	[illegible]	25.34	28.62	8.5	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	38.06	Control tab per Sketch **13**
12-16-55	73	2770	3010	25.34	28.62	8.5	0.9	3.62	30	0.9	0.4	30	79.5	18.5	101.5	3	8.9	39.06	Control tab per Sketch 14

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM RANGE		WING SETTINGS			FLAP SETTINGS						GROUND PLANE		PROPELLER DATA						REMARKS
							FORWARD			AFT											
		LOWEST	HIGHEST	A	B	C	D	E	F	G	H	I	J	K	DIAMETER	NO. OF BLADES	BLADE ANGLE	BLADE STATION	L	M	
2-2-56	74.1	2915	2915	26.00	29.13	13.00	0.05	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	6.50	Hinged spoiler as
	74.2	2885	2885	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	0	shown in sketch,
	74.3	2900	2900	26.00	29.13	13.00	3.75	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	20.00	Fig. No.
	74.4	2895	2895	26.00	29.13	13.00	6.38	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	40.00	
	74.5	2930	2930	26.00	29.13	13.00	8.63	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	60.00	
	74.6	2940	2940	26.00	29.13	13.00	10.38	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	80.00	
	74.7	2925	2925	26.00	29.13	13.00	11.50	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25	94.50	
2-3-56	75.1	2905	2905	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25		All gaps and joints
	75.2	2910	2910	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R	10.25		sealed with adhesive
	75.3	2925	2925	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.0	79.50	18.50	101.5	3	8.9	.75R	10.25		tape
2-6-56	76.1	2915	2915	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R			L.E. of vane 25° right*
	76.2	2915	2915	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	5.9	.75R			L.E. of vane 12.50° right*
	76.3	2950	2950	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.0	79.50	18.50	101.5	3	8.9	.75R			Vane neutral*
	76.4	2920	2920	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R			L.E. of vane -12.50° left*
	76.5	2835	2885	26.00	29.13	13.00	0.90	3.63	30.00	0.90	0.40	30.00	79.50	18.50	101.5	3	8.9	.75R			L.E. of vane -25° left*
2-28-56	77.1	2915	2915	26.00	29.13	13.00	0.90	5.90	35.00	0.90	2.00	25.00	79.50	18.50	101.5	3	8.9	.75R	9.75		
	77.2	3010	3010	26.00	29.13	13.00	0.90	5.90	35.00	0.90	2.00	25.00	79.50	18.50	101.5	3	8.9	.75R	9.75		
	77.3	2915	2915	26.00	29.13	13.00	0.90	5.63	35.00	0.90	2.00	25.00	79.50	18.50	101.5	3	8.9	.75R	9.75		
	77.4	2995	2995	26.00	29.13	13.00	0.90	5.63	35.00	0.90	2.00	25.00	79.50	18.50	101.5	3	8.9	.75R	9.75		
3-5-56	78.1	2890	2890	26.00	29.13	13.00	1.10	4.50	40.00	-0.50	-1.75	30.00	79.50	18.50	101.5	3	8.9	.75R	6.50		
	78.2	2885	2885	26.00	29.13	13.00	0.90	3.75	35.00	1.00	00.75	35.00	79.50	18.50	101.5	3	8.9	.75R	9.13		
	78.3	2920	2920	26.00	29.13	13.00	0.75	3.13	30.00	1.88	2.75	33.50	79.50	18.50	101.5	3	8.9	.75R	12.13		
	78.4	2900	2900	26.00	29.13	13.00	0.50	2.63	25.00	2.63	5.75	31.00	79.50	18.50	101.5	3	8.9	.75R	16.38		
	78.5	2925	2925	26.00	29.13	13.00	0.45	2.00	[illegible]	3.13	8.85	28.50	79.50	18.50	101.5	3	8.9	.75R	20.00		
	78.6	2900	2900	26.00	29.13	13.00	0.35	1.50	15.00	3.31	12.50	25.00	79.50	18.50	101.5	3	8.9	.75R	26.50		
	78.7	2955	2955	26.00	29.13	13.00	0.10	0.82	8.50	2.75	19.00	18.00	79.50	18.50	101.5	3	8.9	.75R	37.75		
	78.8	2925	2925	26.00	29.13	13.00	0.03	0.50	4.50	3.00	23.75	12.50	79.50	18.50	101.5	3	8.9	.75R	45.00		

*See sketch, Fig. No.

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
1.0	556.	1.07135	.09534	5.0353	.06089	.61507	-.04005
1.0	560.	1.02934	.09466	5.2542	.05293	.58211	-.01652
1.0	606.	1.05618	.10788	5.8320	.05692	.60769	-.01953
1.0	651.	1.07003	.06242	3.3335	.02764	.62075	-.04523
1.0	728.	1.05367	.07767	4.2158	.02833	.60708	-.03456
1.0	848.	1.08168	.08125	4.2962	.09738	.62828	-.04336
1.0	994.	1.02057	.06577	3.6872	.05215	.58081	-.04381
1.0	1073.	1.03601	.11527	6.3488	.05962	.59774	-.02964
1.0	1150.	.98815	.06299	3.6474	.00480	.56202	-.03472
1.0	1259.	.99523	.05894	3.3892	.03495	.56202	-.03732
2.0	600.	1.03828	-.02945	-1.6247	.12115	.60967	-.08470
2.0	642.	1.06118	-.05779	-3.1171	.12917	.62491	-.10407
2.0	712.	1.07790	-.02978	-1.5825	.13273	.61710	-.08120
2.0	792.	1.06050	-.00392	-.4819	.13776	.62150	-.06325
2.0	890.	1.03108	-.01786	-.9923	.10741	.59048	-.08314
2.0	1009.	1.01280	.01225	.6929	.09693	.57832	-.06514
2.0	1166.	.98857	-.00151	-.0875	.09557	.57272	-.09392
2.0	1222.	.98938	-.01012	-.5860	.11459	.56281	-.08048
2.0	1150.	.97910	.05992	3.5020	.17449	.56507	.02758
2.0	849.	1.00572	-.01873	-1.0669	.08667	.59644	-.09726
3.0	590.	.99731	.08066	4.6352	.00354	.58267	-.00492
3.0	626.	1.01900	.05363	3.0126	.03979	.58532	-.02544
3.0	717.	.95128	.07393	4.4438	.00684	.55690	-.01314
3.0	777.	1.00062	.07504	4.2887	.00034	.57385	-.04093
3.0	846.	.98144	.06251	3.6443	-.00325	.57522	-.03007
3.0	981.	1.00689	.06664	3.7865	.01033	.59240	-.04149
3.0	1152.	.94946	.06135	3.6970	.01895	.54356	-.03819
3.0	1166.	.99867	.07880	4.5115	.00632	.58591	-.02753
3.0	1267.	.95393	.10041	6.0087	-.03581	.57786	-.00939
4.0	585.	1.03939	.03473	1.9137	.00773	.61455	-.03392
4.0	662.	1.01192	.03069	1.7371	.05088	.60926	-.03262
4.0	670.	1.06313	.04615	2.4856	.02157	.63398	-.04196
4.0	770.	1.03980	.06310	3.4727	.02791	.62117	-.01726
4.0	877.	.98346	.02719	1.5836	.03528	.59099	-.03508
4.0	1002.	1.02830	.01675	.9332	.03898	.60524	-.06768
4.0	1083.	1.01013	.01060	.6012	.03644	.59397	-.05842

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
4.0	1192.	.99929	.02594	1.4869	.04217	.58815	-.05566
4.0	1237.	1.01008	.03213	1.8219	.01585	.59744	-.05086
5.0	700.	1.00242	.03912	2.2348	-.01449	.59905	-.10056
5.0	768.	.99419	.05176	2.9802	-.01871	.59152	-.10009
5.0	875.	.99984	.05351	3.0634	-.01079	.59433	-.09240
5.0	980.	1.00270	.02794	1.5961	-.00984	.59713	-.09781
5.0	1080.	.99330	.02863	1.6509	-.01166	.58624	-.09879
5.0	1188.	1.00563	.04833	2.7514	-.01545	.59123	-.09304
5.0	1260.	1.00426	.04417	2.5183	.00296	.59106	-.08586
6.0	429.	1.03522	.00823	.4554	.01556	.47201	-.06397
6.0	470.	1.04642	-.00375	-.2053	.03378	.49678	-.07453
6.0	510.	1.04057	-.00692	-.3810	.04478	.48368	-.07054
6.0	544.	1.05024	.00000		.02280	.49030	-.07252
6.0	600.	1.05824	.02650	1.4344	.01952	.49231	-.05967
6.0	650.	1.03936	-.01087	-.5991	.02739	.47879	-.08529
6.0	702.	1.03033	.03020	1.6789	-.01836	.47736	-.04925
6.0	740.	1.07532	.00000		.01661	.49671	-.07537
6.0	799.	1.07775	.00884	.4699	.00547	.50233	-.07993
6.0	832.	1.12632	.00849	.4318	.02487	.51901	-.08714
6.1	452.	1.00013	-.07623	-4.3586	.02435	.46834	-.06299
6.1	472.	1.03263	-.00561	-.3112	.02184	.48842	-.08220
6.1	530.	1.04298	.00833	.4575	.01218	.48389	-.06002
6.1	573.	1.03255	-.00462	-.2563	.00789	.47863	-.06784
6.1	635.	1.03469	.00417	.2309	.01986	.48119	-.06536
6.1	685.	1.01334	.03482	1.9680	-.01726	.47351	-.05755
6.1	752.	1.03584	.01762	.9745	-.00320	.48222	-.06384
6.1	797.	1.05495	.02771	1.5046	.01250	.49222	-.06460
6.1	828.	1.10082	.01387	.7218	.01220	.51328	-.07434
6.1	851.	1.16035	.01557	.7687	.00745	.53925	-.07892
7.0	288.	1.02667	-.03067	-1.7110	.01055	.48800	-.07212
7.0	322.	1.01155	.02195	1.2430	-.02010	.46682	-.03778
7.0	353.	1.02283	-.03503	-1.9614	.02793	.47866	-.06700
7.0	382.	1.01919	-.03237	-1.8191	.05309	.47003	-.07510
7.0	409.	1.03400	-.06480	-3.5859	.06618	.48566	-.07093
7.0	566.	.83772	-.01873	-1.2808	.03405	.38621	-.05834

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
7.0	498.	1.01597	- .02128	- 1.1999	.04388	.47312	- .05885
7.0	565.	.99870	- .00625	- .3585	.01645	.46154	- .06599
7.0	600.	1.02585	- .00294	- .1642	.01266	.47620	- .06307
7.0	632.	1.06896	- .02516	- 1.3483	.02294	.49151	- .07817
8.0	947.	.27522	.62134	66.1092	- .22214	.13859	.31014
8.0	1040.	.27609	.63544	66.5157	- .19786	.13343	.31323
8.0	1140.	.25807	.55800	65.1798	- .19492	.13900	.30329
8.1	920.	.29386	.63189	65.0592	- .18177	.16149	.32728
8.1	977.	.30203	.60588	63.5038	- .17669	.16911	.30963
8.1	1178.	.28200	.57900	64.0317	- .18316	.16047	.29300
8.1	717.	.30805	.58407	62.1919	- .14202	.17163	.29744
9.0	866.	.35311	.64681	61.3687	- .21751	.20700	.33202
9.0	1010.	.36575	.61407	59.2212	- .19427	.19231	.30646
9.0	1158.	.34341	.56916	58.8947	- .19640	.19332	.28493
10.0	882.	.40057	.71020	60.5759	- .23708	.21733	.34473
10.0	1050.	.37519	.66893	60.7127	- .26858	.19381	.36134
10.0	1150.	.38097	.65839	59.9446	- .24148	.21683	.33111
10.1	902.	.41324	.67486	58.5194	- .20092	.22671	.35745
10.1	1010.	.39529	.67268	59.5600	- .22647	.21302	.34710
10.1	1112.	.38923	.62846	58.2294	- .20653	.21376	.32677
10.1	900.	.42005	.66655	57.7814	- .19344	.23062	.35417
11.0	955.	.32431	.78266	67.4924	- .35587	.18908	.37377
11.0	1062.	.34432	.74207	65.1087	- .34163	.19683	.37334
11.0	1180.	.35115	.71428	63.8206	- .31948	.20309	.34953
12.0	950.	.31837	.71424	65.9752	- .26990	.18699	.35701
12.0	1056.	.31876	.69274	65.2907	- .25931	.18021	.34264
12.0	1167.	.29601	.67076	66.1878	- .26228	.17346	.32489
13.0	936.	.30173	.70226	66.7489	- .26826	.16082	.35609
13.0	1048.	.28635	.67948	67.1482	- .25503	.16456	.33628
13.0	1157.	.28228	.65212	66.5938	- .23625	.15624	.32740
13.0	1290.	.28879	.62461	65.1864	- .23988	.16800	.30311

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
14.0	942.	.25219	.71561	70.5868	- .26278	.09954	.33642
14.0	1071.	.24766	.70696	70.6937	- .25152	.10891	.33467
14.0	1155.	.27419	.63872	66.7571	- .24674	.12210	.29006
15.0	592.	.28721	.63277	65.5870	- .15416	.16588	.33909
15.0	960.	.29716	.66814	66.0225	- .20489	.17085	.34438
15.0	1066.	.28419	.66138	66.7471	- .21304	.17003	.34658
15.0	1150.	.30491	.65455	65.0224	- .21095	.17075	.34737
16.0	939.	.49052	.84962	60.0004	- .38324	.29970	.40929
16.0	1083.	.47950	.80518	59.2253	- .35626	.29330	.38713
16.0	1190.	.47054	.76693	58.4693	- .35052	.28276	.36270
17.0	879.	.44359	.77896	60.3400	- .32736	.27005	.37512
17.0	1028.	.42704	.74856	60.2960	- .30749	.26841	.34840
17.0	1148.	.42396	.74574	60.3813	- .30967	.26712	.34028
18.0	903.	.42778	.71130	58.9770	- .28700	.23121	.37330
18.0	1050.	.45035	.70595	57.4647	- .27729	.25035	.37401
18.0	1208.	.40754	.68090	59.0981	- .30011	.22627	.36542
19.0	976.	.54062	.80927	56.2557	- .33107	.28549	.41998
19.0	1077.	.52438	.75142	55.0906	- .33833	.29025	.39240
19.0	1266.	.49634	.72159	55.4781	- .37429	.27968	.38541
20.0	1000.	.46992	.73418	57.3782	- .34381	.26673	.36559
20.0	1114.	.45356	.70505	57.2467	- .32375	.25288	.35522
20.0	1257.	.45536	.67545	56.0126	- .31522	.25006	.34629
21.0	1042.	.49291	.75801	56.9653	- .35526	.27054	.36031
21.0	1138.	.47772	.73599	57.0130	- .32707	.26436	.36385
21.0	1247.	.49689	.67449	53.6212	- .35356	.26838	.32747
22.0	1179.	.41015	.66543	58.3516	- .28300	.22766	.32927
22.0	1087.	.42698	.67298	57.6064	- .31216	.23156	.31881
22.0	1256.	.44409	.69779	57.5263	- .29804	.23982	.33785
23.0	1172.	.57979	.72368	51.2993	- .33225	.32411	.37630
23.0	1097.	.59562	.67168	48.4346	- [illegible]	.34024	.34353

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{F}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_p
23.0	963.6	.58822	.69865	49.9046	- .33813	.33454	.36411
23.0	1230.	.57862	.68812	49.9405	- .34970	.32517	.35391
24.0	1210.	.51866	.64400	51.1529	- .35184	.29374	.33941
24.0	1092.	.54468	.68285	51.4221	- .36428	.30669	.34450
24.0	969.	.55283	.68017	50.8964	- .36171	.30961	.34930
25.0	1217.	.42945	.69039	58.1167	- .33301	.24372	.35472
25.0	1128.	.43479	.70883	58.4754	- .32453	.24306	.35345
25.0	976.	.45362	.75043	53.8478	- .34173	.27021	.36210
25.0	1255.	.43628	.69772	57.9825	- .37007	.24794	.35756
26.0	1310.	.47457	.74524	5[illegible].5109	- .40044	.25808	.38351
26.0	1216.	.49301	.73891	56.2882	- .38252	.27824	.35965
26.0	1127.	.48508	.76747	57.7050	- .37018	.26178	.39755
26.0	952.	.47980	.76749	57.9882	- .35029	.25342	.39343
27.0	1313.	.42900	.75767	60.4810	- .33837	.22880	.38164
27.0	1200.	.42375	.77453	61.3166	- .31767	.22980	.38832
27.0	1050.	.42707	.79935	61.8856	- .34179	.23324	.39794
27.0	980.	.42873	.77711	61.1145	- .32610	.22365	.40301
28.0	1305.	.41049	.72169	60.3692	- .31183	.24299	.38290
28.0	1205.	.40497	.74492	61.4696	- .31043	.23573	.39354
28.0	1075.	.40956	.74953	61.3468	- .30590	.24003	.39176
29.0	1340.	.39761	.73976	62.3469	- .32313	.20516	.39445
29.0	1265.	.38855	.72775	61.9019	- .31889	.21991	.37937
29.0	990.	.39157	.75499	62.5868	- .30632	.21961	.40397
30.0	1301.	.42172	.75922	60.9493	- .36653	.23975	.38563
30.0	1239.	.40717	.77725	62.3517	- .35527	.22348	.41[illegible]4
30.0	1119.	.41609	.77691	61.8278	- .34643	.22449	.42349
31.0	1212.	.47601	.70854	56.1060	- .27678	.26555	.38373
31.0	1031.	.47649	.72085	56.5348	- .28062	.26462	.39193
31.0	1005.	.46153	.71383	57.1151	- .29698	.25902	.38291
32.0	1197.	.45098	.70119	57.2523	- .37265	.24060	.36898

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
32.0	1119.	.46504	.71058	56.7972	-.34173	.24842	.37814
32.0	1022.	.49016	.72616	55.9805	-.34230	.26304	.38238
33.0	1210.	.43112	.78419	61.1995	-.40214	.23582	.41547
33.0	1144.	.43471	.78928	61.1554	-.42372	.23499	.41758
33.0	983.	.46457	.80710	60.0750	-.41158	.24797	.43778
34.0	1236.	.40283	.76269	62.1583	-.40618	.24231	.42685
34.0	1136.	.42585	.73184	59.8053	-.40815	.25362	.39511
34.0	1020.	.40845	.75443	61.5687	-.38859	.24743	.40947
35.0	1184.	.47873	.73500	56.9224	-.33381	.29784	.40728
35.0	1112.	.47830	.72539	56.6003	-.32000	.29606	.38648
35.0	1013.	.47446	.73174	57.0406	-.33336	.28416	.41212
36.0	1310.	.36456	.73782	63.7058	-.37705	.22285	.41462
36.0	1110.	.38020	.73563	62.7634	-.33875	.21436	.41016
36.0	995.	.37619	.75652	63.5605	-.34520	.22082	.42060
36.0	1308.	.37938	.71868	62.1711	-.35025	.21654	.39251
37.0	694.	.74389	-.00763	-.5376	.04794	.35291	-.05113
37.0	767.	.74220	-.00921	-.7109	.04334	.35454	-.05563
37.0	825.	.73500	-.01927	-1.5018	.04487	.34858	-.05973
37.0	902.	.73103	-.00783	-.6136	.04720	.34610	-.05715
37.0	1016.	.69944	-.00869	-.7118	.03174	.33391	-.04791
37.0	1117.	.68365	-.00316	-.2648	.03339	.32550	-.04814
37.0	1307.	.69077	-.01216	-1.0034	.03391	.32916	-.05035
38.0	608.	.83394	-.02325	-1.5969	.07407	.39789	-.05088
38.0	652.	.83517	-.04065	-2.7865	.09352	.39187	-.06183
38.0	746.	.79152	-.02368	-1.7136	.06663	.37407	-.04868
38.0	774.	.83137	-.02054	-1.4152	.07534	.39222	-.05084
38.0	568.	.80038	-.02850	-2.0393	.06816	.37474	-.05714
38.0	989.	.76677	-.02679	-2.0010	.04422	.36117	-.05747
38.0	1075.	.75292	-.01972	-1.5003	.04314	.34956	-.05159
38.0	1168.	.74423	-.01815	-1.3970	.04018	.35208	-.04995
38.0	1275.	.72489	-.00554	-.4378	.02772	.34116	-.04553
38.0	1360.	.71597	-.01299	-1.0394	.03081	.33413	-.04344
39.0	495.	.83075	.02498	1.7223	.01226	.40852	-.00414

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
39.0	526.	.85234	.04031	2.7076	.00034	.41471	.00129
39.0	569.	.85935	.01863	1.2419	.02843	.40984	-.00753
39.0	625.	.86717	.02261	1.4935	.02056	.41236	-.01244
39.0	696.	.86503	.02284	1.5124	.01414	.41326	-.01545
39.0	760.	.85728	.03255	2.1744	.01454	.41084	-.01032
39.0	838.	.84918	.01686	1.1374	.03173	.40554	-.02273
39.0	945.	.83156	.01495	1.0299	.02159	.40103	-.02427
39.0	1039.	.81585	.00680	.4775	.01370	.38573	-.02644
40.0	870.	.43228	.50268	49.3060	-.18683	.19401	.24160
40.0	986.	.42682	.49551	49.2592	-.20385	.18557	.23639
40.0	1103.	.40094	.46217	49.0578	-.19190	.17605	.21564
41.0	1145.	.54262	.62732	49.1408	-.27724	.31234	.35553
41.0	1045.	.55058	.62140	48.4580	-.27607	.31962	.34981
41.0	955.	.53092	.62631	49.7122	-.26843	.30734	.35177
41.0	1308.	.53369	.60588	48.6247	-.26849	.30481	.33893
42.0	400.	.77528	.04638	3.4235	-.02961	.35967	.01393
42.0	430.	.79105	.05547	4.0111	-.00593	.38139	.00983
42.0	450.	.77553	.04515	3.3318	-.00972	.37075	.00016
42.0	455.	.89128	.06407	4.1116	-.01463	.42459	.00323
42.0	518.	.83746	.08698	5.9295	-.05111	.40746	.01692
42.0	614.	.81875	.06475	4.5217	-.02534	.39396	.02215
42.0	685.	.83134	.05030	3.4624	-.02252	.40132	-.00405
42.0	746.	.84390	.05092	3.4529	-.01892	.39779	.00026
42.0	780.	.83203	.03056	2.1048	.00998	.39532	-.01445
42.0	840.	.82285	.01577	1.0979	.02093	.38720	-.01627
43.0	940.	.72101	.63254	41.2603	-.32311	.36923	.34375
43.0	1056.	.69535	.61493	41.4878	-.30040	.36817	.32040
43.0	1148.	.66767	.62414	43.0700	-.29867	.36384	.33494
44.0	978.	.56883	.67120	49.7193	-.33323	.30569	.35273
44.0	1188.	.51587	.58230	48.4616	-.31433	.27617	.31150
44.0	1225.	.53379	.60943	48.7854	-.32765	.27923	.32943
45.0	947.	.45829	.75848	58.3587	-.41732	.23262	.42847
45.0	1105.	.44144	.76516	60.0182	-.37608	.22105	.43837

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_p
46.0	977.	.36293	.69992	62.5918	- .35143	.20056	.38976
46.0	1080.	.35322	.69043	62.9059	- .35569	.19027	.39035
46.0	1200.	.33704	.68471	63.7918	- .34734	.18960	.38792
47.0	955.	.37694	.68922	61.3253	- .29451	.21033	.36791
47.0	1082.	.35266	.67201	62.3102	- .30209	.19198	.37080
47.0	1195.	.35480	.65874	61.6929	- .28152	.19892	.36076
48.0	943.	.39184	.71392	61.2395	- .24726	.22163	.39071
48.0	1032.	.38924	.68830	60.5114	- .24633	.21747	.38235
48.0	1170.	.36448	.68867	62.1098	- .25798	.21540	.37214
48.0	1303.	.37010	.66753	60.9946	- .25416	.20497	.36645
49.0	972.	.33641	.70625	64.5300	- .26371	.20640	.38522
49.0	1050.	.35050	.70090	63.4316	- .25262	.21497	.38722
49.0	1170.	.33150	.67563	63.8715	- .27214	.20676	.37019
50.0	943.	.32281	.73546	66.3022	- .26032	.21298	.37226
50.0	1078.	.30734	.70893	66.5619	- .25658	.18312	.38794
50.0	1209.	.29921	.69057	66.5738	- .26684	.16281	.37850
51.0	937.	.43793	.70340	58.0940	- .23841	.24862	.39567
51.0	1040.	.43023	.65243	56.5980	- .22987	.24513	.35034
51.0	1187.	.41268	.63415	56.9454	- .22254	.24486	.35514
52.0	985.	.41589	.57674	54.2044	- .11960	.24401	.31094
52.0	1090.	.40897	.57305	54.4855	- .12334	.23383	.30518
52.0	1230.	.40009	.55380	54.1539	- .11930	.24223	.28802
53.0	1010.	.49132	.57996	49.7300	- .10323	.26570	.33260
53.0	1132.	.46907	.58457	51.2557	- .11012	.26296	.33145
53.0	1238.	.47030	.56449	50.2009	- .09398	.26630	.32022
54.0	980.	.39177	.54362	54.2208	- .07174	.24431	.26571
54.0	1107.	.38992	.54510	54.4231	- .07183	.23125	.27232
54.0	1220.	.39146	.52503	53.2919	- .06506	.23544	.26592
55.0	722.	1.01892	.00000				
55.0	792.	1.03844	.00000				

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
55.0	865.	1.03478					
55.0	935.	1.05180					
55.0	1100.	1.01772					
55.0	1208.	.98085					
55.0	1304.	.97775					
55.0	1005.	1.00667					
56.0	850.	1.04380					
56.0	900.	1.07656					
56.0	1045.	1.03860					
56.0	1180.	1.01935					
56.0	1245.	1.01226					
56.0	770.	1.02948					
57.0	527.	.84681					
57.0	558.	.86152					
57.0	609.	.87271					
57.0	648.	.88184					
57.0	715.	.90534					
57.0	806.	.88338					
57.0	976.	.82647					
57.0	1062.	.78949					
57.0	1225.	.79615					
57.0	1314.	.76718					
58.0	820.	.49443	.84040	59.5305	- .42279	.29661	.35363
58.0	779.	.47710	.82339	59.9105	- .41754	.29600	.34715
58.0	722.	.46310	.80763	60.1697	- .42937	.29393	.33545
58.0	659.	.44034	.83925	62.3147	- .44867	.29481	.33300
59.0	975.	.52547	.83637	57.8598	- .45216	.35886	.46505
59.0	1103.	.50454	.81461	58.2274	- .43796	.34534	.43755
59.0	1211.	.50185	.79449	57.7209	- .44850	.34354	.42749
60.0	955.	.27990	.81689	71.0864	- .39455	.25263	.43177
60.0	1075.	.28354	.79638	70.4024	- .36553	.25389	.43944
60.0	1200.	.29114	.74582	68.6762	- .34078	.24297	.40103
61.0	985.	.35430	.80097	66.1383	- .39823	.26978	.43692

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
61.0	1084.	.35689	.77672	65.3220	- .35821	.28037	.42705
61.0	1326.	.35276	.71492	63.7370	- .35763	.25918	.39872
62.0	973.	.26393	.77998	71.3051	- .31199	.20351	.43990
62.0	1086.	.27624	.75577	69.9222	- .29544	.20868	.42465
62.0	1220.	.27486	.72490	69.2347	- .28605	.20314	.40173
63.0	975.	.44170	.80647	61.2906	- .35078	.27081	.47838
63.0	1100.	.42560	.76784	61.0011	- .34148	.27097	.43907
63.0	1182.	.42597	.76540	60.9026	- .34800	.25946	.44781
64.0	998.	.35066	.77903	65.7663	- .27473	.21194	.44418
64.0	1114.	.35416	.76612	65.1899	- .25541	.20729	.44465
64.0	1224.	.33821	.71315	64.6274	- .26335	.19526	.41533
65.0	994.	.39968	.78572	63.0384	- .26139	.23164	.44719
65.0	1095.	.38253	.77618	63.7642	- .27894	.21162	.44098
65.0	1248.	.37245	.72775	62.8974	- .26533	.21072	.40759
66.0	1013.	.39838	.75878	62.2993	- .34586	.24790	.42757
66.0	1103.	.40984	.79779	62.8095	- .32677	.25291	.43307
66.0	1237.	.37544	.73565	62.9624	- .35352	.24071	.40794
67.0	935.	.44159	.81641	61.5913	- .36604	.27161	.45530
67.0	1083.	.43708	.78478	60.8845	- .35245	.26958	.44083
67.0	1165.	.44121	.70978	58.1342	- .30592	.26799	.39919
67.0	1222.	.43797	.72010	58.6917	- .28792	.25536	.42187
68.0	1010.	.45516	.69192	56.6622	- .20641	.27543	.37492
68.0	1116.	.43865	.66895	56.7340	- .20653	.25711	.37533
68.0	1225.	.42576	.65559	56.9990	- .19886	.24733	.36736
69.0	995.	.34709	.67128	62.6584	- .15536	.18574	.38360
69.0	1082.	.33587	.63527	62.1343	- .16567	.18473	.35875
69.0	1223.	.33905	.60681	60.8060	- .14629	.18702	.34583
70.0	1007.	.42757	.72469	59.4592	- .25587	.25103	.41314
70.0	1137.	.42375	.68690	58.3294	- .33144	.24910	.38345
70.0	1245.	.42247	.68409	58.3019	- .27811	.23925	.39563

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
71.0	1053.	.57707	.74254	52.1471	-.37604	.35407	.42806
71.0	1116.	.57176	.71012	51.1603	-.36091	.34566	.40391
71.0	1250.	.56560	.65237	49.0749	-.35882	.33982	.36608
72.0	991.	.53571	.78186	55.5820	-.39041	.31412	.43574
72.0	1104.	.53885	.73544	53.7701	-.40368	.32675	.41206
72.0	1250.	.50701	.71881	54.8029	-.37046	.31220	.38877
73.0	964.	.51721	.75977	55.7551	-.34629	.30106	.43903
73.0	1140.	.47490	.72307	56.7037	-.32186	.26528	.41272
73.0	1240.	.45798	.70323	56.9257	-.31833	.25751	.40300
74.1	1095.	.47631	.69389	55.5329	-.22856	.25875	.35629
74.2	1045.	.49741	.69665	54.4730	-.26334	.27835	.39919
74.3	1068.	.51648	.59396	48.9912	-.24442	.28664	.32698
74.4	1135.	.47353	.54333	48.9267	-.25557	.27622	.28536
74.5	1153.	.46614	.51492	47.8465	-.22579	.26246	.27319
74.6	1145.	.46168	.50463	47.5449	-.23119	.26600	.28580
74.7	1123.	.43611	.49249	48.4744	-.17761	.25534	.26512
75.1	1118.	.48267	.70964	55.7779	-.29400	.27603	.38584
75.2	1150.	.46172	.71140	57.0152	-.31333	.24883	.39329
75.3	1125.	.47827	.72093	56.4394	-.30597	.26779	.40369
76.1	1110.	.44776	.63675	54.8852	-.25163	.25697	.38839
76.2	1106.	.46056	.64065	54.2878	-.28478	.25376	.39936
76.3	1143.	.45184	.66320	55.7332	-.25807	.25110	.35072
76.4	1148.	.46372	.64338	54.2175	-.27843	.25589	.35110
76.5	1092.	.46000	.66181	55.1982	-.28005	.22439	.33774
77.1	1130.	.45782	.65363	54.9915	-.23358	.24861	.34022
77.2	1230.	.44215	.65651	56.0403	-.24565	.24273	.34766
77.3	1130.	.47189	.65988	54.4308	-.23003	.25326	.35660
77.4	1245.	.44959	.63725	54.7964	-.24319	.23841	.33457

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
78.1	1070.	.31343	.74577	67.2041	- .29885	.17289	.40724
78.2	1088.	.38458	.74642	62.7409	- .28409	.19918	.41467
78.3	1117.	.43313	.73812	59.5955	- .26987	.23696	.41019
78.4	1083.	.53972	.74824	54.1963	- .25687	.29744	.41159
78.5	1118.	.60659	.66633	47.6870	- .21973	.34636	.36076
78.6	1110.	.68260	.57721	40.2180	- .21316	.38745	.31089
78.7	1112.	.83392	.39185	25.1683	- .12470	.47012	.20517
78.8	1110.	.91024	.29067	17.7100	- .06244	.52066	.10806

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM	UPPER WING					GROUND PLANE			LOWER WING					REMARKS
			A	B	C	D	E	J	K	L	A_1	B_1	C_1	D_1	E_1	
12-27-55	B 1.1	2900	23.50	49.30	5.00	35.00	29.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 1.2	2900	23.50	49.30	5.00	40.00	37.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Gap/Chord = 1.10
	B 1.3	2905	23.50	49.30	5.00	45.00	44.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Stagger/Chord = -0.30
	B 1.4	2905	23.50	49.30	5.00	50.00	51.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 1.5	2920	23.50	49.30	5.00	55.00	58.50	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
12-27-55	B 2.1	2895	23.50	49.50	10.00	30.00	21.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 2.2	2925	23.50	49.50	10.00	35.00	29.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Gap/Chord = 1.10
	B 2.3	2915	23.50	49.50	10.00	40.00	37.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Stagger/Chord = -0.30
	B 2.4	2930	23.50	49.50	10.00	45.00	44.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 2.5	2930	23.50	49.50	10.00	50.00	51.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
12-28-55	B 3.1	2930	23.50	50.15	25.00	20.00	8.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 3.2	2910	23.50	50.15	25.00	25.00	14.50	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Gap/Chord = 1.10
	B 3.3	2915	23.50	50.15	25.00	30.00	21.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Stagger/Chord = -0.30
	B 3.4	2908	23.50	50.15	25.00	35.00	29.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 3.5	2900	23.50	50.15	25.00	40.00	37.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 3.6	2920	23.50	50.15	25.00	45.00	44.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
12-28-55	B 4.1	2895	23.50	50.00	20.00	25.00	14.50	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 4.2	2925	23.50	50.00	20.00	30.00	21.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Gap/Chord = 1.10
	B 4.3	2925	23.50	50.00	20.00	35.00	29.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Stagger/Chord = -0.30
	B 4.4	2905	23.50	50.00	20.00	40.00	37.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 4.5	2910	23.50	50.00	20.00	45.00	44.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
12-28-55	B 5.1	2915	23.50	49.80	15.00	25.00	14.50	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 5.2	2905	23.50	49.80	15.00	30.00	21.50	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Gap/Chord = 1.10
	B 5.3	2928	23.50	49.80	15.00	35.00	24.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	Stagger/Chord = -0.30
	B 5.4	2900	23.50	49.80	15.00	40.00	37.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	
	B 5.5	2925	23.50	49.80	15.00	45.00	44.00	79.50	18.50	7.25	21.50	37.00	5.00	50.00	51.00	

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM	UPPER WING					GROUND PLANE			LOWER WING					REMARKS
			A	B	C	D	E	J	K	L	A_1	B_1	C_1	D_1	E_1	
12-29-55	B 6.1	2910	23.50	50.00	20.00	40.00	37.00	79.50	18.50	9.00	21.50	37.00	5.00	40.00	37.00	
	B 6.2	2925	23.50	50.00	20.00	40.00	37.00	79.50	18.50	7.88	21.50	37.00	5.00	45.00	44.00	Gap/Chord = 1.10
	B 6.3	2928	23.50	50.00	20.00	40.00	37.00	79.50	18.50	7.38	21.50	37.00	5.00	50.00	51.00	Stagger/Chord = -0.30
	B 6.4	2905	23.50	50.00	20.00	40.00	37.00	79.50	18.50	7.25	21.50	37.00	5.00	55.00	58.50	
	B 6.5	2915	23.50	50.00	20.00	40.00	37.00	79.50	18.50	10.75	21.50	37.00	5.00	35.00	29.00	
12-29-55	B 7.1	2915	23.50	50.00	20.00	32.50	25.00	79.50	18.50	7.50	21.50	37.00	5.00	47.50	48.00	
	B 7.2	2905	23.50	50.00	20.00	35.00	29.00	79.50	18.50	7.88	21.50	37.00	5.00	45.00	44.00	Gap/Chord = 1.10
	B 7.3	2900	23.50	50.00	20.00	37.50	33.00	79.50	18.50	8.50	21.50	37.00	5.00	42.50	40.50	Stagger/Chord = -0.30
	B 7.4	2880	23.50	50.00	20.00	40.00	37.00	79.50	18.50	9.13	21.50	37.00	5.00	40.00	37.00	
	B 7.5	2930	23.50	50.00	20.00	42.50	40.50	79.50	18.50	10.00	21.50	37.00	5.00	37.50	33.00	
	B 7.6	2900	23.50	50.00	20.00	45.00	44.00	79.50	18.50	10.75	21.50	37.00	5.00	35.00	29.00	
	B 7.7	2930	23.50	50.00	20.00	47.50	48.00	79.50	18.50	11.88	21.50	37.00	5.00	32.50	25.00	
1-6-56	B 8.1	2920	19.00	52.00	20.00	40.00	37.00	79.50	18.50	16.00	17.50	38.75	5.00	35.00	29.00	
	B 8.2	2915	19.00	52.00	20.00	40.00	37.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Gap/Chord = 0.89
	B 8.3	2900	19.00	52.00	20.00	40.00	37.00	79.50	18.50	13.25	17.50	38.75	5.00	45.00	44.00	Stagger/Chord = -0.32
	B 8.4	2918	19.00	52.00	20.00	40.00	37.00	79.50	18.50	13.00	17.50	38.75	5.00	50.00	51.00	
1-6-56	B 9.1	2880	19.00	52.00	20.00	25.00	14.50	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
	B 9.2	2920	19.00	52.00	20.00	30.00	21.50	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Gap/Chord = 0.89
	B 9.3	2923	19.00	52.00	20.00	35.00	29.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Stagger/Chord = -0.32
	B 9.4	2920	19.00	52.00	20.00	40.00	37.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
	B 9.5	2930	19.00	52.00	20.00	45.00	44.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
1-6-56	B10.1	2905	19.00	51.80	15.00	25.00	14.50	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
	B10.2	2885	19.00	51.80	15.00	30.00	21.50	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Gap/Chord = 0.89
	B10.3	2917	19.00	51.80	15.00	35.00	29.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Stagger/Chord = -0.32
	B10.4	2930	19.00	51.80	15.00	40.00	37.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
	B10.5	2920	19.00	51.80	15.00	45.00	44.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM	UPPER WING					GROUND PLANE			LOWER WING					REMARKS
			A	B	C	D	E	J	K	L	A_1	B_1	C_1	D_1	E_1	
1-9-56	B11.1	2925	19.00	52.20	25.00	20.00	8.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
	B11.2	2910	19.00	52.20	25.00	25.00	14.50	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Gap/Chord = 0.89
	B11.3	2918	19.00	52.20	25.00	30.00	21.50	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	Stagger/Chord = -0.33
	B11.4	2930	19.00	52.20	25.00	35.00	29.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
	B11.5	2925	19.00	52.20	25.00	40.00	37.00	79.50	18.50	14.38	17.50	38.75	5.00	40.00	37.00	
1-10-56	B12.1	2918	15.75	63.50	20.00	30.00	21.50	79.50	18.50	15.75	13.00	50.70	5.00	40.00	37.00	
	B12.2	2905	15.75	63.50	20.00	35.00	29.00	79.50	18.50	15.75	13.00	50.70	5.00	40.00	37.00	Gap/Chord = 0.70
	B12.3	2905	15.75	63.50	20.00	40.00	37.00	79.50	18.50	15.75	13.00	50.70	5.00	40.00	37.00	Stagger/Chord = -0.31
	B12.4	2920	15.75	63.50	20.00	45.00	44.00	79.50	18.50	15.75	13.00	50.70	5.00	40.00	37.00	
1-11-56	B13.1	2895	15.75	74.75	20.00	30.00	21.50	79.50	18.50	17.00	12.75	47.75	5.00	40.00	37.00	
	B13.2	2915	15.75	74.75	20.00	35.00	29.00	79.50	18.50	17.00	12.75	47.75	5.00	40.00	37.00	Gap/Chord = 0.70
	B13.3	2910	15.75	74.75	20.00	40.00	37.00	79.50	18.50	17.00	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -0.66
	B13.4	2910	15.75	74.75	20.00	45.00	44.00	79.50	18.50	17.00	12.75	47.75	5.00	40.00	37.00	
1-13-56	B14.1	2910	15.75	86.50	20.00	30.00	21.50	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B14.2	2915	15.75	86.50	20.00	35.00	29.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Gap/Chord = 0.695
	B14.3	2895	15.75	86.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -0.945
	B14.4	2935	15.75	86.50	20.00	45.00	44.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B14.5	2925	15.75	86.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	42.50	40.50	
1-16-56	B15.1	2890	15.75	98.50	20.00	30.00	21.50	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B15.2	2910	15.75	98.50	20.00	35.00	29.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Gap/Chord = 0.695
	B15.3	2900	15.75	98.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -1.24
	B15.4	2915	15.75	98.50	20.00	45.00	44.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B15.5	2940	15.75	98.50	20.00	42.50	40.50	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM	UPPER WING					GROUND PLANE			LOWER WING					REMARKS
			A	B	C	D	E	J	K	L	A_1	B_1	C_1	D_1	E_1	
1-16-56	B16.1	2910	15.75	110.50	20.00	30.00	21.50	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B16.2	2918	15.75	110.50	20.00	35.00	29.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Gap/Chord = 0.695
	B16.3	2910	15.75	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -1.53
	B16.4	2900	15.75	110.50	20.00	45.00	44.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B16.5	2900	15.75	110.50	20.00	47.50	48.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
1-17-56	B17.1	2910	20.50	110.50	20.00	30.00	21.50	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B17.2	2910	20.50	110.50	20.00	35.00	29.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Gap/Chord = 0.81
	B17.3	2917	20.50	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -1.53
	B17.4	2920	20.50	110.50	20.00	45.00	44.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
1-18-56	B18.1	2930	15.75	122.50	20.00	30.00	21.50	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
	B18.2	2900	15.75	122.50	20.00	35.00	29.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Gap/Chord = 0.695
	B18.3	2900	15.75	122.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -1.82
	B18.4	2905	15.75	122.50	20.00	45.00	44.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	
1-19-56	B19.1	2920	15.75	110.50	20.00	42.50	40.50	79.50	18.50	19.00	12.75	47.75	7.50	30.00	21.50	
	B19.2	2920	15.75	110.50	20.00	42.50	40.50	79.50	18.50	16.75	12.75	47.75	7.50	35.00	29.[illegible]	Gap/Chord = 0.695
	B19.3	2910	15.75	110.50	20.00	42.50	40.50	79.50	18.50	15.50	12.75	47.75	7.50	40.00	37.00	Stagger/Chord = -1.53
	B19.4	2920	15.75	110.50	20.00	42.50	40.50	79.50	18.50	14.75	12.75	47.75	7.50	45.00	44.00	
1-19-56	B20.1	2915	15.75	110.50	20.00	42.50	40.50	79.50	18.50	18.00	12.75	47.75	10.00	30.00	21.50	
	B20.2	2900	15.75	110.50	20.00	42.50	40.50	79.50	18.50	15.75	12.75	47.75	10.00	35.00	29.00	Gap/Chord = 0.695
	B20.3	2900	15.75	110.50	20.00	42.50	40.50	79.50	18.50	14.50	12.75	47.75	10.00	40.00	37.00	Stagger/Chord = -1.53
	B20.4	2930	15.75	110.50	20.00	42.50	40.50	79.50	18.50	13.75	12.75	47.75	10.00	45.00	44.00	
1-19-56	B21.1	2930	15.75	110.50	20.00	42.50	40.50	79.50	18.50	19.25	12.75	48.00	12.50	25.00	14.50	
	B21.2	2895	15.75	110.50	20.00	42.50	40.50	79.50	18.50	16.50	12.75	48.00	12.50	30.00	21.50	Gap/Chord = 0.695
	B21.3	2895	15.75	110.50	20.00	42.50	40.50	79.50	18.50	14.50	12.75	48.00	12.50	35.00	29.00	Stagger/Chord = -1.525
	B21.4	2920	15.75	110.50	20.00	42.50	40.50	79.50	18.50	13.50	12.75	48.00	12.50	40.00	37.00	

RUN SCHEDULE FOR MODEL 88 TESTS

DATE	RUN NO.	RPM	UPPER WING					GROUND PLANE			LOWER WING					REMARKS
			A	B	C	D	E	J	K	L	A_1	B_1	C_1	D_1	E_1	
1-20-56	B22.1	2925	15.75	110.50	20.00	37.50	33.00	79.50	18.50	16.00	12.75	47.75	5.00	42.50	40.50	
	B22.2	2895	15.75	110.50	20.00	38.75	35.00	79.50	18.50	16.20	12.75	47.75	5.00	41.25	38.75	Gap/Chord = 0.695
	B22.3	2920	15.75	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -1.53
	B22.4	2930	15.75	110.50	20.00	41.25	38.75	79.50	18.50	17.30	12.75	47.75	5.00	38.75	35.00	
	B22.5	2920	15.75	110.50	20.00	42.50	40.50	79.50	18.50	17.50	12.75	47.75	5.00	37.50	33.00	
	B22.6	2922	15.75	110.50	20.00	43.75	42.50	79.50	18.50	18.25	12.75	47.75	5.00	36.25	31.00	
1-23-56	B23.1	2890	15.75	110.50	20.00	37.50	33.00	101.50	0	66.50	12.75	47.75	5.00	42.50	40.50	
	B23.2	2920	15.75	110.50	20.00	38.75	35.00	101.50	0	66.50	12.75	47.75	5.00	41.25	38.75	Gap/Chord = 0.695
	B23.3	2925	15.75	110.50	20.00	40.00	37.00	101.50	0	66.50	12.75	47.75	5.00	40.00	37.00	Stagger/Chord = -1.53
	B23.4	2940	15.75	110.50	20.00	41.25	38.75	101.50	0	66.50	12.75	47.75	5.00	38.75	35.00	Ground Plane Removed
	B23.5	2900	15.75	110.50	20.00	42.50	40.50	101.50	0	66.50	12.75	47.75	5.00	37.50	33.00	
	B23.6	2920	15.75	110.50	20.00	43.75	42.50	101.50	0	66.50	12.75	47.75	5.00	36.25	31.00	
1-26-56	B24.1	2900	15.75	110.50	20.00	37.50	33.00	See	Remarks		12.75	47.75	5.00	42.50	40.50	Gap/Chord = 0.695
	B24.2	2895	15.75	110.50	20.00	38.75	35.00	"	"		12.75	47.75	5.00	41.25	38.75	Stagger/Chord = -1.53
	B24.3	2930	15.75	110.50	20.00	40.00	37.00	"	"		12.75	47.75	5.00	40.00	37.00	Wing tested in inverted position
	B24.4	2930	15.75	110.50	20.00	41.25	38.75	"	"		12.75	47.75	5.00	38.75	35.00	to simulate ground plane at
	B24.5	2935	15.75	110.50	20.00	42.50	40.50	"	"		12.75	47.75	5.00	37.50	33.00	infinite distance
	B24.6	2920	15.75	110.50	20.00	43.75	42.50	"	"		12.75	47.75	5.00	36.25	31.00	700 Lb. Counterweight Removed
2-16-56	B25.1	2885	15.75	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Vane angle for 25.1 = -10°
	B25.2	2920	15.75	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Vane angle for 25.[illegible] = 5°
	B25.3	2890	15.75	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Vane angle for 25.3 = 20°
	B25.4	2900	15.75	110.50	20.00	40.00	37.00	79.50	18.50	16.50	12.75	47.75	5.00	40.00	37.00	Vane angle for 25.4 = 35°
																Gap/Chord = 0.695 Stagger/Chord = -1.53

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
B 1.1	1125.	.66047	.52146	38.2921	- .32575	.29475	.21139
B 1.2	1117.	.60825	.51728	40.3791	- .33121	.26287	.20936
B 1.3	1116.	.54739	.54308	44.7735	- .30695	.23901	.22240
B 1.4	1121.	.49766	.57849	49.2954	- .32726	.22184	.23654
B 1.5	1127.	.49188	.54091	47.7179	- .27952	.21532	.22745
B 2.1	1088.	.66109	.54975	39.7462	- .31388	.29255	.22167
B 2.2	1124.	.62193	.55729	41.8624	- .28710	.26569	.22524
B 2.3	1126.	.55648	.57356	45.8659	- .29278	.24359	.23608
B 2.4	1129.	.51651	.59291	48.9394	- .28098	.23068	.25056
B 2.5	1115.	.48449	.59507	50.8484	- .25959	.20451	.25589
B 3.1	1120.	.67499	.52536	37.8944	- .26736	.31097	.21658
B 3.2	1102.	.61920	.55800	42.0239	- .25713	.28227	.23266
B 3.3	1113.	.56422	.60011	46.7655	- .26442	.25713	.25007
B 3.4	1118.	.50163	.61481	50.7886	- .24362	.22861	.25385
B 3.5	1139.	.46642	.60400	52.3240	- .23437	.21152	.25592
B 3.6	1137.	.42332	.57656	53.7132	- .23250	.19623	.23710
B 4.1	1064.	.67121	.58041	40.8506	- .28388	.30427	.23345
B 4.2	1100.	.60319	.59515	44.6155	- .30843	.27167	.24148
B 4.3	1099.	.53782	.63750	49.8477	- .27586	.24068	.26771
B 4.4	1112.	.49975	.65229	52.5425	- .27319	.22386	.26937
B 4.5	1127.	.46331	.61539	53.0249	- .25734	.20785	.24985
B 5.1	1094.	.69390	.54996	38.3990	- .27725	.30886	.21261
B 5.2	1100.	.67298	.57588	40.5541	- .29326	.29415	.22814
B 5.3	1133.	.58649	.59341	45.3360	- .28077	.25797	.24266
B 5.4	1108.	.54213	.60680	48.2216	- .30029	.23655	.24171
B 5.5	1138.	.48454	.61720	51.8659	- .27333	.21654	.24946
B 6.1	1122.	.52811	.62522	49.8129	- .23344	.23876	.25904
B 6.2	1130.	.50247	.61610	50.8004	- .24992	.22755	.25740
B 6.3	1125.	.48900	.60941	51.2559	- .25604	.22142	.25648
B 6.4	1118.	.47784	.57530	50.2872	- .26325	.21583	.24416

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_l
B 6.5	1135.	.54541	.61027	48.2122	- .21562	.25089	.25367
B 7.1	1118.	.59559	.60059	45.2394	- .27731	.25953	.24601
B 7.2	1106.	.58163	.62148	46.8970	- .26058	.25787	.25105
B 7.3	1150.	.55323	.59309	46.9914	- .27195	.24947	.23828
B 7.4	1122.	.54184	.60159	47.9912	- .23733	.24424	.24148
B 7.5	1145.	.53713	.57099	46.7502	- .19394	.23087	.23366
B 7.6	1127.	.53317	.56757	46.7900	- .21008	.23538	.23172
B 7.7	1147.	.55622	.53148	43.6970	- .18530	.25930	.22434
B 8.1	1129.	.57352	.63230	47.7907	- .28819	.25676	.27073
B 8.2	1142.	.53055	.66997	51.6242	- .28940	.23420	.29372
B 8.3	1150.	.48998	.64380	52.7261	- .29069	.22440	.26910
B 8.4	1167.	.47695	.63593	53.1299	- .32847	.21776	.26587
B 9.1	1097.	.68493	.60161	41.2945	- .12522	.28684	.25146
B 9.2	1116.	.61187	.63729	46.1657	- .12117	.25459	.26851
B 9.3	1134.	.54918	.63029	48.9339	- .13309	.23308	.26240
B 9.4	1136.	.50622	.62451	50.9722	- .15216	.21021	.26966
B 9.5	1157.	.48634	.61623	51.7188	- .12798	.20485	.25980
B10.1	1107.	.71652	.56026	38.0224	- .09302	.31612	.21805
B10.2	1123.	.68446	.59476	40.9889	- .10858	.30429	.23770
B10.3	1122.	.61910	.62994	45.4972	- .11288	.26790	.26031
B10.4	1146.	.54754	.63371	49.1722	- .12423	.24573	.25510
B10.5	1145.	.52024	.61574	49.8054	- .09593	.23546	.25132
B11.1	1089.	.68726	.55249	38.7958	- .11555	.31535	.20549
B11.2	1104.	.64502	.58019	41.9711	- .12741	.29640	.21444
B11.3	1092.	.59062	.58333	44.6442	- .12327	.26787	.21557
B11.4	1111.	.54076	.59880	47.9156	- .12018	.23828	.23339
B11.5	1105.	.41736	.59406	54.9098	- .28561	.24458	.22674
B12.1	1126.	.66241	.62613	43.3872	- .06348	.29993	.25458

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	Θ DEG.	C_m	C_n	C_ℓ
B12.2	1106.	.62557	.65823	46.4572	-.06401	.26488	.28119
B12.3	1172.	.59034	.62116	46.4572	-.08182	.25472	.27043
B12.4	1150.	.57244	.54239	43.4559	-.08864	.26529	.21619
B13.1	1096.	.63029	.71260	48.5074	.00113	.28062	.28784
B13.2	1092.	.58298	.69579	50.0414	.02237	.25671	.28608
B13.3	1095.	.53458	.72132	53.4573	.01557	.24138	.29535
B13.4	1098.	.52829	.70165	53.0229	.02121	.24295	.28643
B14.1	1104.	.61292	.72824	49.9145	.10989	.26054	.29148
B14.2	1123.	.56356	.74110	52.7492	.08441	.24645	.29153
B14.3	1125.	.56099	.71779	51.9905	.04834	.23246	.30307
B14.4	1145.	.52513	.69136	52.7811	.06876	.21844	.29377
B14.5	1130.	.51159	.71149	54.2823	.05265	.23010	.28587
B15.1	1050.	.61705	.80188	52.4215	.27273	.26594	.33247
B15.2	1074.	.56377	.81522	55.3339	.23925	.24579	.32549
B15.3	1100.	.54242	.84896	57.4245	.21328	.24517	.34588
B15.4	1054.	.50406	.77201	56.8587	.16715	.21335	.31709
B15.5	1078.	.54201	.76138	54.5537	.23104	.21688	.32113
B16.1	1106.	.59956	.79642	53.0268	.35660	.24851	.32298
B16.2	1102.	.55203	.80412	55.5303	.31550	.22318	.33320
B16.3	1102.	.54722	.79290	55.3885	.29494	.20970	.34471
B16.4	1091.	.52376	.83329	57.8488	.34811	.20798	.36199
B16.5	1083.	.52600	.76928	55.6373	.32005	.21217	.32051
B17.1	1115.	.59622	.74562	51.3531	.33674	.21837	.31584
B17.2	1103.	.54539	.78257	55.1265	.33883	.22302	.32653
B17.3	1103.	.51175	.79058	57.0846	.30662	.20187	.33698
B17.4	1112.	.47741	.78736	58.7697	.28868	.19923	.32666
B18.1	1092.	.58523	.78317	53.2307	.42316	.23270	.33019
B18.2	1096.	.57180	.81256	54.8658	.43343	.22257	.35376

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	θ DEG.	C_m	C_n	C_ℓ
B18.3	1070.	.53781	.81909	56.7113	.41555	.19689	.35886
B18.4	1088.	.49480	.81204	58.6448	.37363	.20594	.33968
B19.1	1129.	.57100	.82793	55.4070	.37837	.25059	.30445
B19.2	1133.	.53467	.84217	57.5896	.38862	.23444	.31896
B19.3	1102.	.50803	.81134	57.9467	.37546	.21858	.29886
B19.4	1108.	.45743	.81333	60.6458	.36099	.19250	.29810
B20.1	1092.	.55601	.79531	55.0421	.30685	.25028	.30511
B20.2	1092.	.52382	.82767	57.6708	.35660	.24468	.32466
B20.3	1095.	.49173	.81088	58.7667	.32924	.22512	.31058
B20.4	1110.	.45325	.80788	60.7059	.30145	.19911	.31572
B21.1	1107.	.61073	.71749	49.5954	.34995	.26845	.26470
B21.2	1093.	.56215	.79135	54.6112	.34831	.25379	.30201
B21.3	1096.	.52030	.81820	57.5473	.33872	.23366	.33002
B21.4	1085.	.48975	.76624	57.4149	.31188	.20498	.31014
B22.1	1135.	.50874	.82044	58.1976	.33049	.22386	.32963
B22.2	1123.	.50630	.76627	56.5459	.31010	.20853	.29740
B22.3	1107.	.50405	.79491	57.6213	.30696	.21984	.31845
B22.4	1106.	.52509	.80681	56.9430	.34640	.22100	.33593
B22.5	1100.	.52314	.79033	56.4983	.33174	.22940	.32383
B22.6	1103.	.52652	.78657	56.2021	.30746	.23143	.31547
B23.1	1113.	.50045	.70886	54.7781	.32713	.19032	.27791
B23.2	1113.	.51950	.72315	54.3071	.38835	.23006	.29157
B23.3	1130.	.52888	.72478	53.8813	.40810	.18753	.29551
B23.4	1122.	.52951	.70947	53.2643	.43691	.21302	.27309
B23.5	1096.	.50982	.70696	54.2029	.37694	.18458	.27091
B23.6	1105.	.52006	.70120	53.4367	.38987	.19359	.26752
B24.1	1100.	.50761	- .63531	-50.3135	- .27503	.20609	- .32163
B24.2	1115.	.50712	- .64895	-50.8607	- .24247	.22970	- .32984

AERODYNAMIC CHARACTERISTICS FOR STATIC OPERATION

RUN NO.	THRUST LBS.	$\frac{LF}{T}$	$\frac{L}{T}$	Θ DEG.	C_m	C_n	C_ℓ
B24.3	1196.	.47278	-.63898	-52.1775	-.28087	.21091	-.31581
B24.4	1196.	.44470	-.63455	-53.4403	-.33345	.20477	-.30640
B24.5	1127.	.49406	-.65615	-51.7602	-.29586	.21482	-.32601
B24.6	1092.	.49856	-.64158	-50.9977	-.27669	.21492	-.30691
B25.1	1056.	.53062	.68939	52.4147	.25470	.20367	.28698
B25.2	1079.	.51149	.76640	56.2811	.29865	.16113	.34017
B25.3	1033.	.51031	.85356	59.1264	.48614	.17904	.38025
B25.4	1081.	.48765	.68653	54.6133	.38621	.14559	.32370